3

REPORT RESUMES

ED 002 938 24
EFFECTS OF MOTIVATIONAL FACTORS ON PERCEPTUAL-COGNITIVE
EFFICIENCY OF CHILDREN WHO VARY IN INTELLECTUAL LEVEL.
BY- SHOCK, CHARLES D. AND OTHERS
PURDUE UNIV., LAFAYETTE, IND.
REPORT NUMBER CRP-790 PUB DATE 61
EDRS PRICE MF-$0.27 HC-$6.56 164P.

DESCRIPTORS- ELEMENTARY SCHOOLS, *LEARNING MOTIVATION, *PERCEPTION, *CONCEPT FORMATION, SLOW LEARNERS, HIGH ACHIEVERS, *INTELLIGENCE LEVEL, *CHILD DEVELOPMENT, TEST OF EDUCATIONAL ABILITY, LAFAYETTE, INDIANA, WECHSLER INTELLIGENCE SCALE

THIS STUDY WAS DESIGNED TO INVESTIGATE THE EFFECT OF INCENTIVE MOTIVATIONAL CONDITIONS ON SELECTED ASPECTS OF PERCEPTION AND CONCEPT TRANSFER PERFORMANCE OF SLOW LEARNING, AVERAGE, AND BRIGHT CHILDREN. THE TOTAL POPULATION OF THE FOURTH-GRADE CHILDREN IN A PUBLIC ELEMENTARY SCHOOL SYSTEM WAS ADMINISTERED THE TEST OF EDUCATIONAL ABILITY. CHILDREN WHO SCORED WITHIN THE THREE PRESELECTED RANGES OF INTELLIGENCE LEVEL WERE ADMINISTERED THE WECHSLER INTELLIGENCE SCALE FOR CHILDREN. THE SCORES ON THE TWO TESTS WERE USED TO SELECT THREE GROUPS OF SUBJECTS REPRESENTING LOW, MEDIUM, AND HIGH INTELLIGENCE GROUPS. EACH OF THESE GROUPS WAS FURTHER SUBDIVIDED BY RANDOMLY ASSIGNING ONE-HALF OF THE SUBJECTS TO THE TWO PERCEPTUAL STUDIES AND THE REMAINING SUBJECTS TO THE CONCEPT TRANSFER EXPERIMENTS. THE RESULTS OF THE EXPERIMENTS LENT GENERAL SUPPORT TO THE HYPOTHESIS THAT INCENTIVE MOTIVATION REDUCES THE RANGE AND VARIETY OF STIMULI TO WHICH AN INDIVIDUAL RESPONDS. FURTHER, THE FACILITATIVE EFFECTS OF INCENTIVES OF THE PERCEPTUAL AND CONCEPT TRANSFER TASKS SUGGESTED A "NARROWING OF ATTENTION" UNDER THESE CONDITIONS SUCH THAT IN INCREASED PROPORTION OF RELEVANT TASK CUES ARE ASSIMILATED. (JL)

ED 002938

U. S. DEPARTMENT OF HEALTH, EDUCATION AND WELFARE
Office of Education
This document has been reproduced exactly as received from the person or organization originating it. Points of view or opinions stated do not necessarily represent official Office of Education position or policy.

EFFECTS OF MOTIVATIONAL FACTORS ON PERCEPTUAL-COGNITIVE EFFICIENCY OF CHILDREN WHO VARY IN INTELLECTUAL LEVEL

Cooperative Research Project No. 790

Charles D. Smock, Ph.D.
Purdue University
Lafayette, Indiana, 1962

Research Assistants:

David Shantz	Thomas Gorry
Paul Carlson	Barry Rubin
Irwin Silverman	

The research reported herein was supported through the Cooperative Research Program of the Office of Education, U.S. Department of Health, Education, and Welfare.

ACKNOWLEDGMENTS

The financial and administrative support of the Cooperative Research Program of the United States Office of Education, Department of Health, Education and Welfare to this project is gratefully acknowledged.

Space permits me to extend appreciation to only a few of the many people who made this project possible. The children who so willingly participated in the many types of experiments in the project, and who must remain unnamed, warrant more recognition than is possible here. They were indeed a source of pleasure to all of us concerned with the study. We hope the facts which they helped us obtain play some role in providing better education for other children.

The opportunity to work with the children was made possible only through the efforts of the superintendents, principals, and officials of the Wayne Township School District. The names of the principals of the individual schools are listed in the Appendix. Frank Cline, Elementary School Supervisor, devoted time, energy and effort beyond that expected both in the planning and the implementation of the project. Mary E. McClelland, principal of the Mary McClelland Elementary School, was an ideal principal-research collaborator. Many of the preliminary experiments would not have been possible without her tolerance, patience, and helpfulness. Finally, I would like to extend particular appreciation to the trustee of Wayne Township, Mr. Samuel Lang. Mr. Lang proved to have unusual understanding of our problems and gave continuing support to the study.

Many of the supplementary experiments were conducted in the East Lafayette School District. The time, effort, and support of Mr. Hyiatt and his staff, particularly Mr. Paul Lane and Mr. William Jackson (Principal of Edgelea School), in the final phases of the study are gratefully acknowledged.

Purdue University contributed more than the usual amount of support to this study. The Purdue Research Foundation provided a David Ross Faculty Grant which permitted the original preliminary study to be completed. Purdue University, through a special grant from the President's fund, made it possible to construct and equip the Mobile Psychological Laboratory used for this investigation.

The graduate assistants and students working on theses who participated in this study are recognized on the cover page. In addition, appreciation is extended to Mrs. Janet Crook, secretary with endless patience and a variety of skills whose contributions cannot be measured in usual terms.

TABLE OF CONTENTS

Page

LIST OF TABLES viii

LIST OF FIGURES x

LIST OF APPENDIX FIGURES AND TABLES xii

CHAPTER 1 - INTRODUCTION AND STATEMENT OF THE PROBLEM 1

CHAPTER 2 - GENERAL METHODS AND PROCEDURES 6

Overview of the Design 6
Selection of Subjects 7
Social-Motivational Conditions 10

Task Orientation 10
Incentive Orientation 10

CHAPTER 3 - THE EFFECTS OF INCENTIVE MOTIVATION ON PERCEPTION 12

Introduction 12

Experiment I - The Effect of Incentive Motivation on Complex Form Recognition 12

Introduction 12
Method 13

Subjects 13
Apparatus 13
Stimuli 13
Incentive Motivation 15
Procedure 16
Recording of Responses 16

Results 16

Accuracy Score 16
Certainty Score 18
Decision Time 20

Conclusions 21

TABLE OF CONTENTS (continued)

Page

Experiment II - Form Recognition as a Function of Intelligence, Form Parameter and Perception Time 22

  Introduction 22
  Method 24

    Subjects 24
    Stimulus Material 24
    Task Requirements 25
    Methods of Presentation 25
    Procedure 26

  Results 27

    Tachistoscopic Presentation 27

      Recognition Error 27
      Decision Time 30

    Scanning Method 32
    Practice Effects 35

  Conclusions 35

Experiment III - Effects of Incentive Motivation on Perceptual Span 36

  Introduction 36
  Method 37

    Subjects 37
    Stimulus Material 37
    Experimental Task 38
    Recording of Responses 39
    Motivational Conditions 40
    Procedure 40

  Results 40

    Angular Error 41

      Form Set 41
      Letter Set 43

    Linear Error 44

      Form Set 44
      Letter Set 46

    Constant Error 49

  Conclusions 51

TABLE OF CONTENTS (continued)

Page

Experiment IV - The Effect of Training on Perceptual Span 52

Introduction 52
Method 53

Subjects 53
Stimulus Material 53
Experimental Task 54
Recording of Responses 55
Procedure 55

Results 56

Recognition Accuracy 56
Localization Accuracy 58

Conclusions 61

CHAPTER 4 - EFFECT OF INCENTIVE MOTIVATION ON UTILIZATION OF INCIDENTAL CUES IN CONCEPT TRANSFER 63

Introduction 63

Experiment V - Effects of Incentive Motivation: Utilization of Visual Information in Concept Transfer 65

Introduction 65
Method 66

Subjects 66
Stimulus Material 66
Experimental Task 66
Motivational Conditions 68
Procedure 68

Results 68
Conclusions 73

Experiment VI - Effects of Incentive Motivation: Utilization of Tactile-Kinesthetic Information in Concept Transfer 74

Introduction 74
Method 75

Subjects 75
Task Requirement 75
Motivational Conditions 77
Procedure 77

Results 78
Conclusions 79

TABLE OF CONTENTS (continued)

Page

Experiment VII - Effects of Incentive Motivation: Utilization of Tactile-Kinesthetic Information in Concept Transfer as Related to Level of Spatial Concepts 80

Introduction 80
Method 80

Subjects 80
Task Requirement 81
Orientation Task 81
Procedure 81

Results 82

Transfer 82
Orientation Measure 83
Relationship of Spatial Concept Level to Pattern Transfer . . 84

Conclusions 85

CHAPTER 5 - DISCUSSION AND IMPLICATIONS 87

REFERENCES 101

APPENDIXES 108

LIST OF TABLES

Table | Page

1. Mean and Standard Deviation of Chronological Age, TEA IQ Equivalent, and WISC IQs for Each Intelligence Group 8

2. Part A. Mean and Standard Deviation of TEA IQ Equivalents, WISC IQs, and Chronological Ages for Subjects in Perception Experiments 9

   Part B. Mean and Standard Deviation of TEA IQ Equivalents, WISC IQs, and Chronological Ages for Subjects in Learning Experiments 9

3. Mean Change (Sess. 2-Sess. 1) in Recognition Accuracy as a Function of Intelligence, Motivation and Stimulus Complexity . 16

4. Mean Difference in Uncertainty Between Session 1 and 2 as a Function of Intelligence, Motivation, and Stimulus Complexity . 19

5. Mean Difference (Sess. 2-Sess. 1) in Decision Time as a Function of Intelligence, Motivation, and Stimulus Complexity . 20

6. Mean Recognition Error Under Tachistoscopic Presentation for Each Intelligence Group and Stimulus Dimension 28

7. Mean Decision Time as a Function of Intelligence and Stimulus Dimensions Under Tachistoscopic Presentation (Method A) 31

8. Mean Decision Time as a Function of Intelligence and Stimulus Dimensions Under the Scanning Condition 33

9. Mean Error of Angular Placement for the Form and Letter Sets as a Function of Intelligence, Motivation, and Practice 41

10. Mean Linear Error for the Form and Letter Sets as a Function of Intelligence, Motivation, and Practice 44

11. Mean Errors (Z-Scores) for Forms and Letters as a Function of Intelligence, Motivation, and Practice 48

12. Mean Linear Constant Errors for Form and Letter Sets as a Function of Intelligence, Motivation, and Practice 50

13. Mean Correct Recognition Score in Pre- and Post-Tests as a Function of Training and Stimulus Position 56

LIST OF TABLES (continued)

Table | Page
14. Mean Angular and Linear Error on Pre- and Post-Tests as a Function of Training and Stimulus Position 58
15. Mean Linear Constant Error on Pre- and Post-Tests as a Function of Training and Stimulus Position 60
16. Number of Subjects on Concept Transfer (Visual Cue) Under Each of the Experimental Conditions 66
17. Mean Trials to Criterion on Concept Transfer Task as a Function of Intelligence, Motivation, and Practice for Each Order of Presentation 69
18. Number of Non-Learners on Concept Transfer Task (Visual Cue) in Each Intelligence Group 71
19. Number of Subjects Under Each Experimental Condition in Pattern Transfer Task: Tactile-Kinesthetic Cue 75
20. Mean Errors on Pattern Transfer Task as a Function of Intelligence, Motivation, and Practice 78
21. Mean Correct Response on Pattern Transfer Task as a Function of Intelligence, Motivation, and Practice 82
22. Mean Correct Directional Response as a Function of Intelligence and Orientation 84

LIST OF FIGURES

Figure Page

1. Design of Major Investigations and Number of Subjects under Each Experimental Condition 7
2. Response Arrangement for Complex Form Recognition 14
3. Representative Visual Displays for Complex Form Recognition . 15
4. Mean Correct Recognitions as a Function of Motivation and Practice 17
5. Mean Difference in Recognition Accuracy (Sess. 2-Sess. 1) as a Function of Intelligence Level and Motivation 18
6. Mean Uncertainty as a Function of Motivation and Practice . . 19
7. Mean Decision Time as a Function of Motivation and Practice . 21
8. Representative Visual Display for Complex Form Recognition: Study II 26
9. Response Arrangement for Complex Form Recognition: Study II . 27
10. Mean Recognition Error as a Function of Complexity and Intelligence Level 29
11. Mean Recognition Error as a Function of Complexity and Stimulus Dimension 30
12. Mean Decision Time as a Function of Complexity and Stimulus Dimension (Method A). 32
13. Mean Decision Time as a Function of Complexity and Stimulus Dimension (Method B). 34
14. Stimuli and Representative Visual Displays for Peripheral Localization 39
15. Mean Angular Error for Forms as a Function of Intelligence, Motivation, and Stimulus Position 42
16. Mean Angular Error for Forms as a Function of Intelligence and Stimulus Position 43

LIST OF FIGURES (continued)

Figure Page

17. Mean Linear Error for Forms as a Function of Intelligence, Motivation, and Practice 45

18. Mean Linear Error for Letters as a Function of Intelligence, Motivation, and Practice 46

19. Mean Linear Error for Letters as a Function of Stimulus Position and Practice 47

20. Mean Combined Error (Z-Scores) for Letters as a Function of Intelligence, Motivation, and Practice 49

21. Mean Constant Error for Form and Letter Sets as a Function of Intelligence and Motivation 51

22. Mean Correct Recognition Responses on Pre- and Post Tests as a Function of Training and Stimulus Position 57

23. Mean Linear Error on Pre- and Post-Tests as a Function of Training and Stimulus Position 59

24. Sample Stimuli for Both Sets for Concept Transfer (VM) Task 67

25. Mean Trials to Criterion on Concept Transfer Task as a Function of Intelligence and Order of Cue Training 69

26. Mean Trials to Criterion on Concept Transfer Task as a Function of Intelligence, Motivation, and Practice (Order II) 71

27. Mean Trials to Criterion on Concept Transfer Task for "Learners" as a Function of Intelligence, Motivation, and Practice (Order I) 72

28. Mean Trials to Criterion on Concept Transfer Task for "Learners" as a Function of Intelligence, Motivation, and Practice (Order II) 72

29. Schematic Representation of Pre-training, Incidental Cue Training and Pattern Transfer Mazes 76

30. Mean Error on Pattern Transfer Task as a Function of Intelligence and Practice 79

31. Mean Correct Choice Responses on Pattern Transfer Task as a Function of Intelligence, Motivation, and Practice . . . 83

32. Number of Turns Correct as a Function of Intelligence, Motivation, and Pre-Post Tests 85

LIST OF APPENDIX FIGURES AND TABLES

Appendix A

Figure | Page

1. Purdue Mobile Psychological Laboratory 109

Table

1. List of Elementary Schools and Principals Participating in the Study 110

2. Means and Standard Deviations of TEA Subscores and Total Score 111

3. List of Incentives Used 113

Appendix B

Figure

1. Stimuli and Representative Visual Displays for Complex Form Recognition 114

Table

1. Target Stimuli and Stimulus Location for Each Trial in Complex Form Recognition 115

2. Analysis of Variance of Recognition Accuracy and Decision Certainty Under the Different Experimental Conditions 116

3. Analysis of Variance of Decision Time Under the Different Experimental Conditions 117

Appendix C

Table

1. The Order of Presentation of the Four Levels of Complexity and the Four Dimensions Through the Entire Experimental Procedure 118

LIST OF APPENDIX FIGURES AND TABLES (continued)

Appendix C (continued)

Table | Page

2. Analysis of Variance of Recognition Efficiency Scores for Tachistoscopic (Method A) and Scanning (Method B) Procedures 119

3. Newman-Keuls Test of Differences Between Ordered Means of Recognition Errors for the Tachistoscopic Procedure 120

4. Analysis of Variance of Decision Time for Tachistoscopic Procedure (Method A) Under the Different Experimental Conditions 121

5. Newman-Keuls Test of Differences Between Ordered Means of Decision Time for the Scanning Procedure 122

6. Analysis of Variance of Recognition Efficiency Scores for Tachistoscopic (Method A) and Scanning (Method B) Procedures (Practice Effect) 123

Appendix D

Figure

1. Stimuli and Representative Visual Displays 124

Table

1. Target Stimuli and Stimulus Locations for Each Trial for Peripheral Localization 125

2. Analysis of Variance of Angular Errors for Form and Letter Sets Under the Different Experimental Conditions 126

3. Analysis of Variance of Linear Errors for the Form and Letter Sets Under the Different Experimental Conditions 127

4. Analysis of Variance of Combined Angular and Linear Errors (Z-Scores) for Form and Letter Sets Under the Different Experimental Conditions 128

5. Analysis of Variance of Linear Constant Errors for Form and Letter Sets Under Different Experimental Conditions 129

LIST OF APPENDIX FIGURES AND TABLES (continued)

Appendix E

Figure Page

1. Stimuli and Visual Displays Used for Peripheral Sensitivity II 130

Table

1. Target Stimuli and Stimulus Locations for Peripheral Sensitivity (Experiment IV) 131

2. Analysis of Variance of Recognition Accuracy Scores Under the Different Experimental Conditions 132

3. Analysis of Variance of Angular and Linear Errors Under the Different Experimental Conditions 133

4. Analysis of Variance of Linear Constant Errors Under the Different Experimental Conditions 134

Appendix F

Table

1. Composition of Experimental Trials for Both Stimulus Sets (FC-NS and NS-FC) 135

2. Analysis of Variance of Number of Trials to Criterion on Concept Transfer (VM) Under the Different Experimental Conditions 136

3. Analysis of Variance of Number of Trials to Criterion on Concept Transfer (VM) for Each Order of Presentation 137

4. Analysis of Variance of Number of Trials to Criterion on Concept Transfer (VM) Under the Different Experimental Conditions (Learners Only) 138

Appendix G

Table

1. Analysis of Variance of Errors on Pattern Transfer (KM) Under the Different Experimental Conditions (Experiment VI) . . 139

2. Analysis of Variance of Correct Responses on Pattern Transfer (KM) Under the Different Experimental Conditions (Experiment VII) 140

3. Analysis of Variance of Correct Turns on Orientation Task Under the Different Experimental Conditions 141

CHAPTER 1

INTRODUCTION AND STATEMENT OF THE PROBLEM

The revival of interest in cognitive processes during the last decade is the result of many social and scientific challenges inherent in post war conditions. The theoretical speculations and empirical data emerging from the confrontation of these challenges, particularly the work of Hebb (34), Guilford (31), Piaget (52), are providing new insights and forcing psychologists and educators to adopt new fundamental assumptions concerning the nature of intelligence. Specifically, the level and/or efficiency of adaptation must be considered a joint or interactive function of both the impact of prior experience (learning) and the individual's genetic potential. Intellectual performance, therefore, represents the manifestations (pheno-type) of the accumulative effects of the interaction of genetic and environmental processes over the stages of development. Cognitive efficiency or intelligence may be viewed, then, in much the same way as performance efficiency in man-machine systems; i.e., as a joint function of the prior formed "capacity" (dependent upon both genetic and experiential factors) of the cognitive-perceptual systems of the individual and the congruence of these systems to the requirements of the environmental system.

One major implication derived from this broad working assumption is that quantitative differences in intellectual performance level may be a function either of the individual's information processing capacities or of the characteristics of the environmental event-structure. Montessori's (49) emphasis on "sense training" during early childhood, and the educational methodologies she developed, represent implicit recognition of the fundamental importance of a "programmed" environment to match the learning capacities of the young child. More recently, the theories of Piaget (52), Werner (93), the excellent review and discussion of "experience and intelligence" by Hunt (37), development of special methods for educating slow-learning and brain-injured children (40) and the recognition of the different modes of learning that appear in children from different social class backgrounds (58) indicate a growing acceptance of the impact of special environments on intelligence.

The purpose of this investigation was to explore a single aspect of the complex problem of determining the variables that regulate the acquisition and modification of perceptual and cognitive information processing characteristics of children who vary in intelligence level. Specifically, the study was designed to investigate the effect of incentive motivational conditions on selected aspects of perception and concept transfer performance of slow learning, average, and bright children.

Analysis of effects of motivation on cognitive processes has enjoyed considerable popularity during the last few years. However, the guiding assumptions and current theoretical context of the problem led investigators to concern themselves with the motivation determinants of stimulus selectivity (e.g., perceptual defense) rather than perceptual-cognitive organization. Only recently has sufficient attention been given to the analysis of motivation and cognitive-perceptual processes as interdependent aspects of performance (35,37,78). Performance proficiency on a variety of tasks, ranging from simple learning to problem solving, requires the differentiation of relevant from irrelevant environmental cues and the integration of these cues or environmental event-components into appropriate cognitive or symbolic units mediating behavior. The individual always is confronted with a wide range of possible "cues", but perceptual responses are required to only a portion of the "stimulus" complex with other components remaining as undifferentiated context. Tolman (88) early proposed that motivational arousal and/or over-learning (mechanization) produced a constricting effect on perception and cognition; i.e., reduced the assimilation of environmental information. Investigation of the effects of psychological stress on the assimilation of information under conditions of environmental uncertainty (38,48,74,75), intolerance of ambiguity in children (cf. 76), the role of motoric tension (feedback) on utilization of visual information (66,69,78) and the analysis of qualitatively different kinds of environmental "novelty" on information seeking or curiosity in preschool children (76) all lend support to Tolman's hypothesis concerning the direct perceptual consequences of motivation. Data from the investigation of latent (e.g., 82) and irrelevant cue learning (2,3,24,36,39) also lend strong support to the generalization that motivation or drive arousal leads to a reduction in "range and variety environmental cues to which the organism responds" (13, p. 9). The hypothesis that performance proficiency is, to an important degree, a function of "breadth" of cue utilization which in turn is regulated by the level of emotionality or drive arousal appears to have substantial empirical support (cf. 13,23,39).

Application of the principle--that motivational arousal reduces efficiency of cue utilization--to educational practice is complicated by several methodological characteristics of prior investigations. It is difficult, in many studies, to determine whether variation in performance was a function of the individual's failure to differentiate clearly the relevant from the irrelevant objects (perception) or a failure to associate the correct responses with the relevant cues (learning). Secondly, the motivational variables represent highly restricted samples of conditions, e.g., psychological stress, induced muscle tension and electric shock, etc., that appear to have relatively little relevance to the social-motivational condition characterizing most educational situations. Thirdly, with the exception of Sarason et al. (46,62,90) and Malpass et al. (44,45) the relationship of emotional and motivational factors to "intelligence", and particularly the possible accumulative effects of a chronically high level of emotionality (11,26,28,37) has received little research attention. Finally, research on the interdependency of cognitive efficiency and emotional-motivation factors has been concentrated on adult and adolescent subjects (cf. 47). There is an obvious need, therefore, for information on the effects of motivation on both perceptual and cognitive proficiency of children who vary in intellectual level under motivational conditions that have more direct application to educational situations.

The general purposes of this study were, then, to: a) study the perceptual and learning proficiency of children under motivational conditions closely similar to those used in classroom situations; and b) to determine if these motivational conditions differentially affect the perceptual and learning proficiency of dull, average and bright children. Specifically, the study was designed to determine the extent to which incentive motivation would affect the breadth and amount of cue utilization in both perceptual (object/shape identification and breadth of perceptual span) and incidental learning (concept formation and transfer) tasks. On the basis of the theoretical considerations and prior research presented above, it was predicted that:

1. Range and breadth of cue utilization in both perceptual and learning tasks will vary as a function of incentive motivational level.

2. Cue utilization efficiency (proportion of relevant to irrelevant cue) in both perceptual and learning tasks will be positively related to intellectual level.

3. Cue utilization proficiency will vary as a function of both intellectual level and incentive motivation; however the exact form of the interaction is not predicted.

CHAPTER 2

GENERAL METHODS AND PROCEDURES

Overview of the Design

The project consists of four main experiments and several supplementary studies.[1] The detailed procedure for each experiment is presented in the relevant section. The purpose of this section is to provide an overview of the design, the method of selecting subjects and the experimental conditions common to the main series of experiments.

Four main experiments were conducted: 1) Complex Form Recognition (CFR); 2) Perceptual Span (PS); 3) Concept Formation and Transfer-Visual Modality (CFT-VM); and 4) Concept Formation and Transfer-Kinesthetic Modality (CFT-KM). The perceptual (CFR and PS) and concept transfer (CFT-V and K) tasks were presented to different groups of subjects. All subjects were seen in two experimental sessions. The experimental tasks were administered under "task oriented" conditions in Session 1 and under "incentive oriented" conditions in Session 2. In order to attribute differences in performance between the two sessions to the effects of the motivational condition, a control group received task oriented instructions in both Sessions 1 and 2. The design of the investigation and the number of subjects performing under each of the experimental conditions are summarized in Figure 1.

---

[1] Two further experiments were conducted concerning the effect of motivation on perception but are not reported as part of the main investigation. The studies were designed to determine if affectivity had a progressive influence on perceptual organization with increasing age. A total of 70 children, of low, medium and high intelligence level, were presented with objects of varying affective value under conditions where the positive and negative stimuli induced perceptual conflict. While the data yielded suggestive trends with age, as predicted, serious methodological problems prevented clear interpretation of the data in terms of the hypothesized processes operating. A brief note relevant to these problems where the binocular fusion paridigm of "perceptual conflict" is used will be published.

Figure 1

Design of Major Investigations and Number of Subjects under Each Experimental Condition[1,2]

		Intelligence Level					
		Low		Medium		High	
		Exp.	Control	Exp.	Control	Exp.	Control
Complex Form Recognition (I)	Session 1	T(12)	T(13)	T(18)	T(19)	T(15)	T(15)
	Session 2	I(12)	T(13)	I(18)	T(19)	I(15)	T(15)
Peripheral Sensitivity (III)	Session 1	T(12)	T(13)	T(18)	T(19)	T(15)	T(15)
	Session 2	I(12)	T(13)	I(18)	T(19)	I(15)	T(15)
Concept Transfer; Visual Cue (V)	Session 1	T(12)	T(11)	T(13)	T(15)	T(12)	T(12)
	Session 2	I(12)	T(11)	I(13)	T(15)	I(12)	T(12)
Concept Transfer; Tactile Cue (VI)	Session 1	T(4)	T(4)	T(10)	T(7)	T(9)	T(10)
	Session 2	I(4)	T(4)	I(10)	T(7)	I(9)	T(10)

---

[1] Does not include *Ss* in the supplementary experiments.

[2] T = Task orientation, I = Incentive orientation; number in parentheses refers to number of *Ss*.

Selection of Subjects

Ss were selected from the fourth grade of ten elementary schools in the Wayne Township (Indiana) public school district (See Appendix A, Table 1). The total population of fourth grade children (N = 783) was administered the Test of Educational Ability (TEA; 83) in the classroom situation. Means and standard deviations of each sub-test and total scores on the TEA for boys and girls in each of the ten schools are presented in Table 2, Appendix A.

Total TEA scores were transformed to IQ equivalent using Standard-Binet Transformation tables. The Wechsler Intelligence Scale for Children (WISC; 92) then was individually administered to the children in each of the Low (TEA IQ = 80-90), Medium (TEA IQ = 105-110) and High (TEA IQ = 115+) categories. Experimental Ss were selected on the basis of both TEA classification and full-scale WISC IQ. Table 1 presents the means and standard deviations of the TEA IQ equivalents, WISC IQ's, and chronological ages for boys and girls in each of the three intelligence groups that constituted the original experimental sample. This subject pool, then, was further divided by randomly assigning one-half of the Ss to the perceptual studies (CFR and PS), and the remaining Ss to the learning (CFT-VM and KM) experiments. Relevant descriptive data for these two experimental groups are presented in Table 2.

Table 1

Mean and Standard Deviation of Chronological Age, TEA IQ Equivalent, and WISC IQ's for Each Intelligence Group

Intelligence Level	Sex	Chronological Age	TEA (IQ Equivalent)	WISC (Total IQ)
Low	Boys	$\bar{X}$ = 10.18	$\bar{X}$ = 89.60	$\bar{X}$ = 89.20
	(N=20)	s = .54	s = 9.63	s = 6.20
	Girls	$\bar{X}$ = 10.13	$\bar{X}$ = 90.03	$\bar{X}$ = 86.33
	(N=34)	s = 1.84	s = 9.22	s = 8.29
Medium	Boys	$\bar{X}$ = 9.86	$\bar{X}$ = 105.33	$\bar{X}$ = 106.78
	(N=36)	s = .54	s = 11.51	s = 3.38
	Girls	$\bar{X}$ = 9.86	$\bar{X}$ = 108.82	$\bar{X}$ = 105.05
	(N=38)	s = 3.58	s = 9.99	s = 3.79
High	Boys	$\bar{X}$ = 9.63	$\bar{X}$ = 117.58	$\bar{X}$ = 120.67
	(N=24)	s = .87	s = 8.50	s = 5.33
	Girls	$\bar{X}$ = 9.74	$\bar{X}$ = 118.74	$\bar{X}$ = 120.39
	(N=32)	s = 1.74	s = 8.00	s = 6.96

Table 2

Part A.

Mean and Standard Deviation of TEA IQ Equivalents, WISC IQs, and Chronological Ages for Subjects in Perception Experiments

Intelligence Levels	Measure	TEA IQ Equivalent Scores	WISC IQ	Chronological Age
Low	$\bar{X}$	89.41	85.92	10.16
	s	9.72	3.29	6.62
Medium	$\bar{X}$	107.70	105.92	9.72
	s	9.58	5.61	4.20
High	$\bar{X}$	117.21	119.12	9.72
	s	7.69	4.05	2.34

Part B.

Mean and Standard Deviation of TEA IQ Equivalents, WISC IQs, and Chronological Ages for Subjects in Learning Experiments

Intelligence Levels	Measure	TEA IQ Equivalent Scores	WISC IQ	Chronological Age
Low	$\bar{X}$	90.64	88.93	10.08
	s	8.78	6.92	6.14
Medium	$\bar{X}$	105.82	106.19	9.96
	s	12.18	.36	.38
High	$\bar{X}$	118.98	121.56	9.69
	s	19.84	18.74	.38

Social-Motivational Conditions

The independent variable throughout these investigations was "incentive" motivation. The motivational level was experimentally controlled by varying the instructional sets for the task conditions. The crucial instructions that differentiated the two experimental motovational conditions were as follows:

Task Orientation. "We want to find out if boys and girls like you like this game. You want to do as well as you can, but remember that it is not part of your school work and your teacher will not be told how well you do."

Incentive Orientation. S was shown a display of toys consisting of puzzles, baseballs, model airplane kits, paper children's books, candy bars, pencil, and etc., which have been shown in previous work to be of high preference value for children of this age. S was instructed as follows:

> "Before we begin I want to show you some prizes which are all worth about the same amount of money. These are prizes that you can win if you do very well today. Which one of these prizes would you like to have most of all? You may pick any one. O.K. Are you sure that's the one you like best? I'll put it here on the table (in front of S). Remember if you do very well you can keep the prize, but if you don't do well we will keep the prize. Are there any questions?"

In addition, each subject was reminded at predetermined intervals during the task that it was necessary to do "well" in order to get to keep the prize at the end of the task. A complete list of the classes of toys offered as prizes may be found in Appendix A, Table 3.

At the termination of all experimental testing (i.e., both sessions) in a particular school, "prizes" were distributed to all participants including those in the Task-oriented condition.

All data were collected in the Purdue Mobile Psychological Laboratory. A description and diagram of the laboratory are contained in Appendix A, Figure 1.

CHAPTER 3

THE EFFECTS OF INCENTIVE MOTIVATION ON PERCEPTION

Introduction

Prior research has indicated that increases in motivational arousal have two direct perceptual consequences that might have accumulative effects in the course of cognitive development and thus could account for many perceptual learning difficulties during later childhood. First, increases in motivational level tend to modify the number of visual informational attributes of stimulus configurations that are utilized (3,6,17,24,25,78); and second, motivation arousal reduces the "span" of the perceptual field, e.g., produces tunnel vision (4,8,14,16). The experiments presented below were designed to determine the extent to which incentive motivation tends to generate such perceptual consequences, and whether this effect varies with the child's intelligence level.

Experiment I

The Effect of Incentive Motivation on Complex Form Recognition

Introduction

Shape and form recognition are basic to object recognition as well as many complex learning activities, e.g., reading. The purpose of this investigation was to determine the effects of incentive motivation on recognition of forms which vary in degree of familiarity and complexity. If incentive motivation reduces assimilation of relevant attributes of form or objects (visual information) then it would be expected that perceptual efficiency would change relatively less with each increase in stimulus complexity or unfamiliarity; that is, the number of cues "omitted" would become a smaller and smaller proportion of available relevant cues as motivation was increased. Further, it was expected that the "dull" children might suffer a greater loss in perceptual efficiency under the higher level of motivation than the relatively "bright" children.

Method

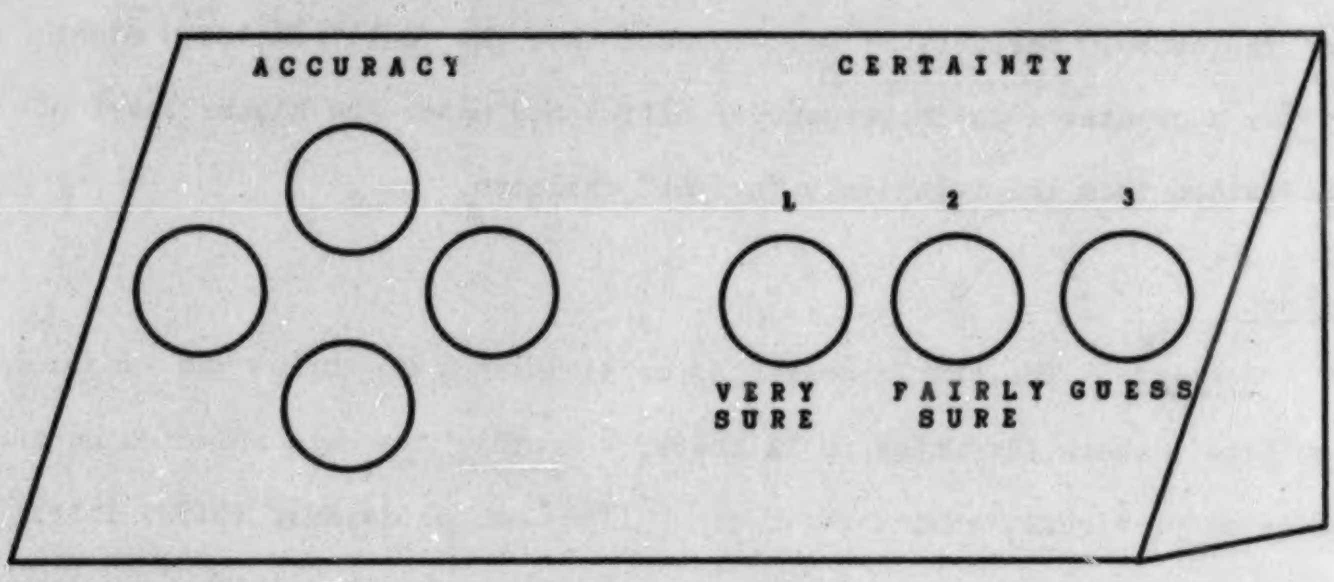
Subjects. The sample consisted of 42 males & 50 females who ranged in age from 9 years, 4 months to 12 years, 4 months. Ss were selected on the basis of previously administered group (TEA) and individual (WISC) intelligence measures so that they formed Low, Medium and High intelligence level groups with respective Mean IQ's of 83, 106, and 119 (cf. Table 2, p. 9).

Apparatus. The experiment was conducted in the perceptual-learning Mobile Laboratory described in Appendix A, Figure 1. S sat at a table 8 ft. in front of the screen on which the stimulus display was projected. A response panel in front of S contained four buttons arranged North, South, East and West which corresponded to the position of the target stimuli in the visual displays. Three response buttons were arranged horizontally to the right of this configuration so that S could indicate the degree of "certainty" associated with each stimulus selection (Figure 2). Depression of the response button activated a corresponding light on the signal board in the control room from which E recorded both the Ss stimulus choices and degree of certainty associated with that choice.

Stimuli. Three classes of stimuli, representing three levels of complexity, were used in this experiment. Familiar Forms (FF) consisted of a dog, fish, bird and cat. Four randomly generated forms with 8 sides (8 S)

Figure 2

Response Arrangement for Complex Form Recognition

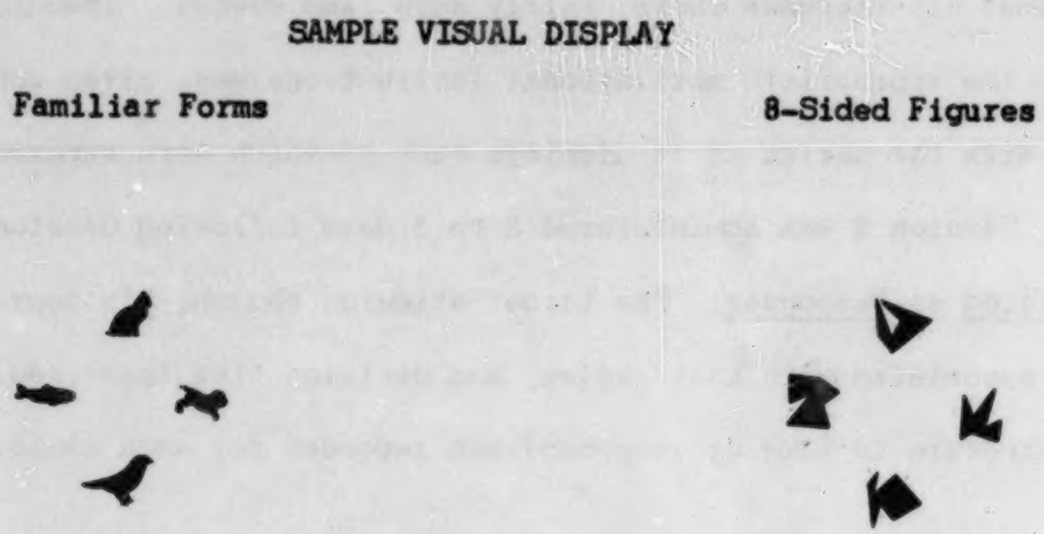


and a second set of four such forms with 16 sides (16 S) constituted the two classes of unfamiliar forms. Twelve slides for each of the three sets of forms were constructed. Each slide contained all four members of a set but in a different arrangement of positions. Sample displays for each set are present in Figure 3, while the complete trial series is presented in Table 1, Appendix B.

Each form was designated the correct response three times, thus making a total of 36 trials for all sets. The order of the displays for the total series of trials was randomly selected. Replicas of each form of each set were constructed to serve as standard stimuli. The replicas were mounted in a book in the same random order in which the stimulus appeared in the total series of trials. The form which the child was to "look for" was

Figure 3

Representative Visual Displays for Complex Form Recognition



designated to him and then a warning light appeared in the center of the screen for 2 sec. prior to presentation of each display.

Incentive Motivation. The experiment was conducted in two sessions. Session 1 was designed to obtain baseline data and all subjects were administered the task under non-incentive (Task-Oriented) instructions. In Session 2 one-half of the subjects were administered Task instructions (Group T-T) while the remaining half were administered the task under Incentive motivational instruction (Group T-I). The detailed instructions associated with the different motivational conditions are presented in Chapter 2, 10.

Procedure. A brief familiarization period designed to accustom S to the apparatus was followed by instructions to teach him: a) to press the button corresponding to the position to which he saw the comparison stimulus and b) to press the button corresponding to the degree of certainty he felt about his response (Sure, Fairly sure, and Guess). Immediately following, the appropriate motivational instructions were given and S was presented with the series of 36 displays each of which were exposed for 200 msec. Session 2 was administered 2 to 3 days following Session 1.[2]

Recording of Responses. The target stimulus chosen, S's degree of certainty associated with that choice, and decision time (measured from stimulus exposure to time of response) was recorded for each child.

Results

Accuracy Score. Table 3 presents the mean change in recognition accuracy (Session 2 - Session 1) relevant to the effects of incentive motivation and intelligence on form recognition. The analysis of variance of the data on which these change scores are based is presented in Appendix B, Table 2. Since incentive motivation was introduced in Session 2, its

Table 3

Mean Change (Sess. 2-Sess. 1) in Recognition Accuracy as a Function of Intelligence, Motivation and Stimulus Complexity

	Task Orientation (T-T)			Incentive Orientation (T-I)		
	FF	8-Side	16-Side	FF	8-Side	16-Side
Low	.36	.67	1.25	1.30	1.85	1.70
Medium	.84	1.22	1.29	.50	1.14	1.02
High	.94	.87	1.23	.91	2.90	2.78

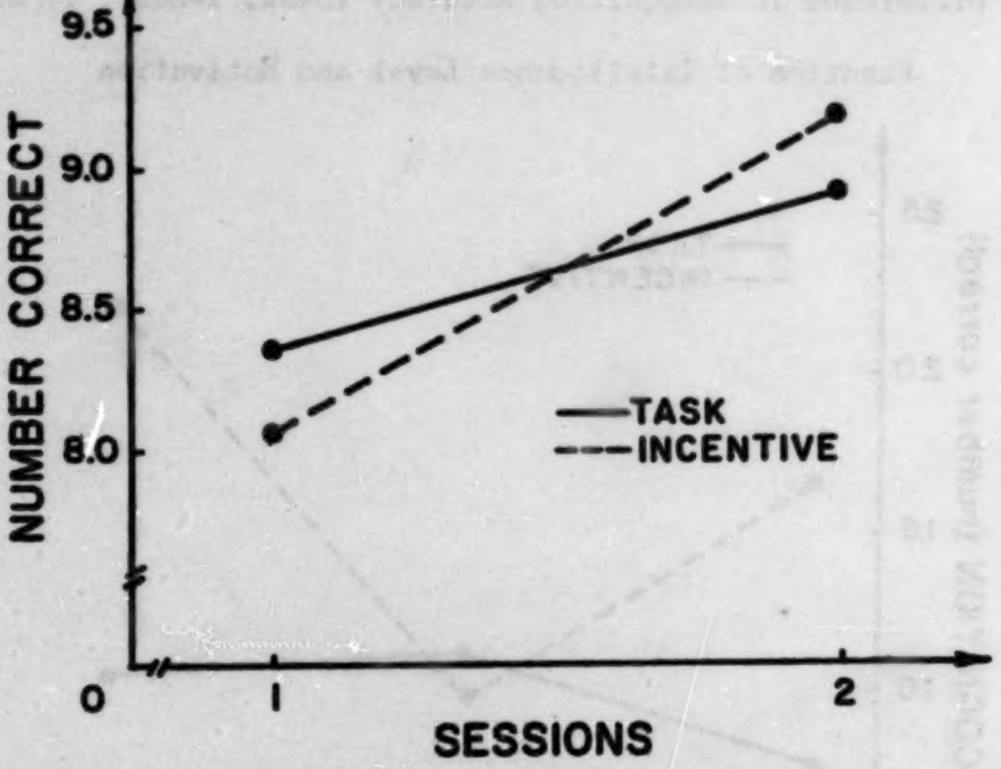
---

[2] One-half of the Ss in each group received the Complex Form Recognition Task first (in each session) and the Perceptual Span Task (Exp. III) second. The order of tasks was reversed for the remaining Ss.

effects are reflected in the motivation x session interaction presented in Figure 4.

Figure 4

Mean Correct Recognitions as a Function of Motivation and Practice



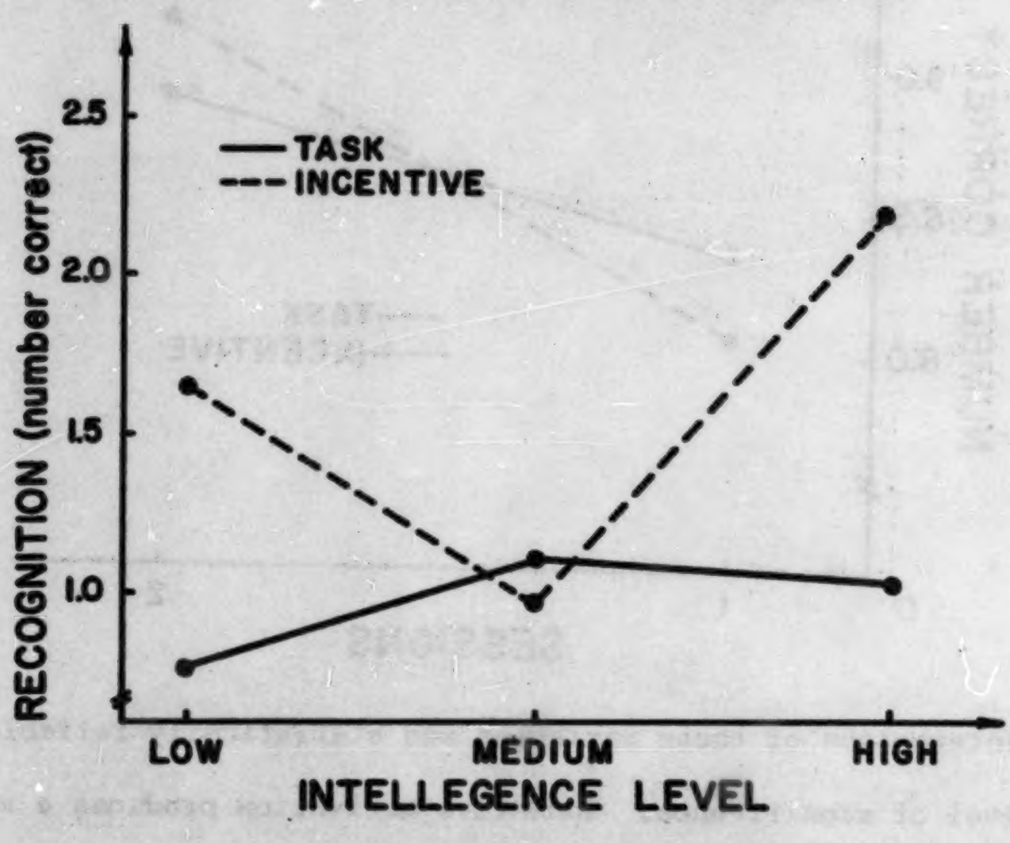
The interaction of these variables was statistically reliable beyond the .05 level of significance. Incentive motivation produces a significant increment in performance beyond that associated with the highly significant practice effects (Session; p = < .001) although no other of the interactions associated with the practice variable reached a satisfactory level of statistical significance (Appendix B, Table 2). Incentive motivation, therefore, appears to exert equal influence on form recognition accuracy at each level of stimulus complexity. The data may be interpreted as indicating that motivation modified the proportion of cues utilized, rather than an absolute number of cues.

Analysis of variance (Appendix B, Table 2) indicated that intellectual level was a systematic influence on level of recognition accuracy (p = .01).

Further, incentive motivation exerted some differential effect on recognition efficiency at the different intelligence levels (p = .10). Figure 5 illustrates the nature of these differential effects.

Figure 5

Mean Difference in Recognition Accuracy (Sess. 2-Sess. 1) as a Function of Intelligence Level and Motivation



Certainty Score. Table 4 presents the mean change in degree of confidence (Sess. 2-Sess. 1) for the three intelligence groups at each level of stimulus complexity.

The summary analysis of variance of the data on which the means in Table 4 are based is presented in Appendix B, Table 2. As might be expected, increasing stimulus complexity is associated with an increasing degree of uncertainty; the respective means were: FF = 1.34; 8 S = 1.63; and 16 S = 1.63. Motivation had a differential effect on confidence level in the two sessions (F = 9.25, p = <.01). Figure 6 illustrates the fact that incentive

Table 4

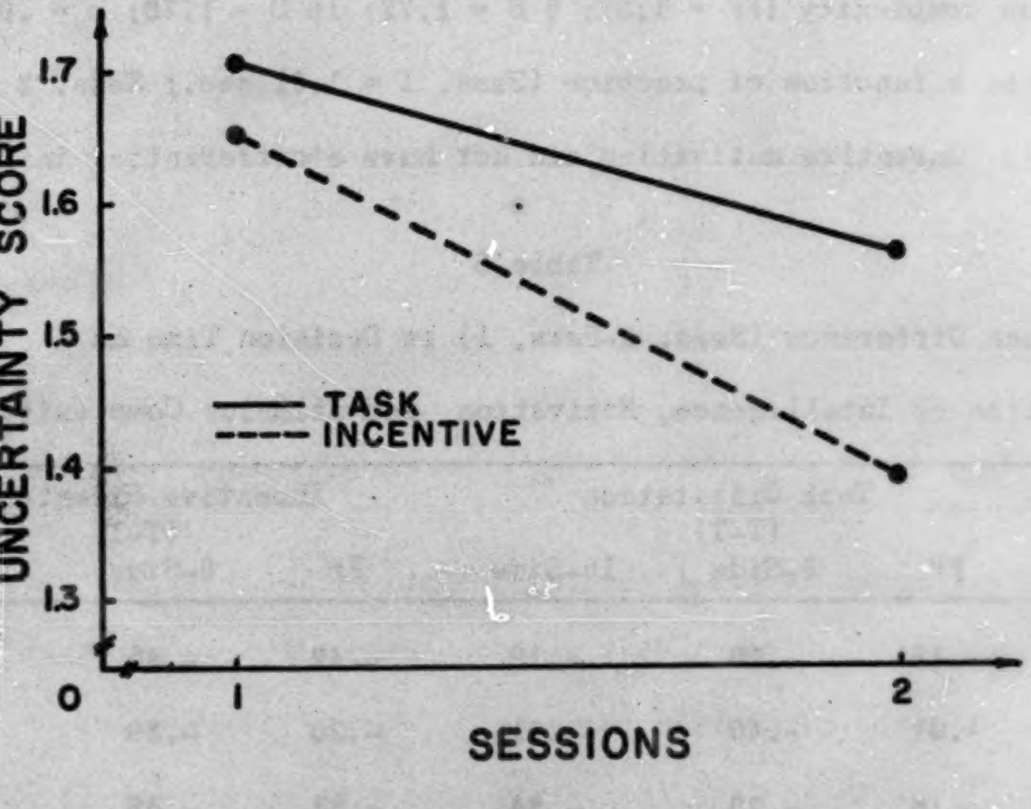
Mean Difference in Uncertainty Between Session 1 and 2 as a Function of Intelligence, Motivation, and Stimulus Complexity[1]

	Task Orientation (T-T)			Incentive Orientation (T-I)		
	FF	8-Side	16-Side	FF	8-Side	16-Side
Low	-1.78	-1.28	-0.25	-2.80	-4.65	-3.85
Medium	-0.65	-3.26	-1.68	-1.61	-2.78	-3.29
High	-1.94	-2.08	-2.83	-0.90	-4.10	-4.37

[1] Minus sign indicates an increase in confidence or certainty rating.

Figure 6

Mean Uncertainty as a Function of Motivation and Practice[1]



[1] Larger scores are indicative of greater uncertainty.

motivation increased subjective certainty over that associated with practice alone.

These data in conjunction with those reported for recognition accuracy suggest that subjective certainty increases as recognition accuracy increases. However, the magnitude of the correlation of accuracy and certainty ($r = +.36$) indicates *Ss'* evaluation of their own performance (degree of confidence) does not show a high degree of congruence with reality (accuracy of recognition). The significance of this discrepancy will be discussed in a later section.

Decision Time. Apparatus difficulties prevented obtaining decision time measures on several *Ss*, so the data reported are based on only 52 of the 92 *Ss* (N = 25 T-T and 27 T-I). The data relevant to the relationship of intelligence, motivation, and stimulus complexity to decision time are presented in Table 5. Analysis of variance of the decision time scores is presented in Table 3, Appendix B. Mean decision time increased as a function of stimulus complexity (FF = 1.57; 8 S = 1.77; 16 S = 1.78; $p = .05$) and decreased as a function of practice (Sess. 1 = 1.81 sec.; Sess. 2 = 1.59 sec.; $p = < .01$). Incentive motivation did not have a differential influence at

Table 5

Mean Difference (Sess. 2-Sess. 1) in Decision Time as a Function of Intelligence, Motivation, and Stimulus Complexity[1]

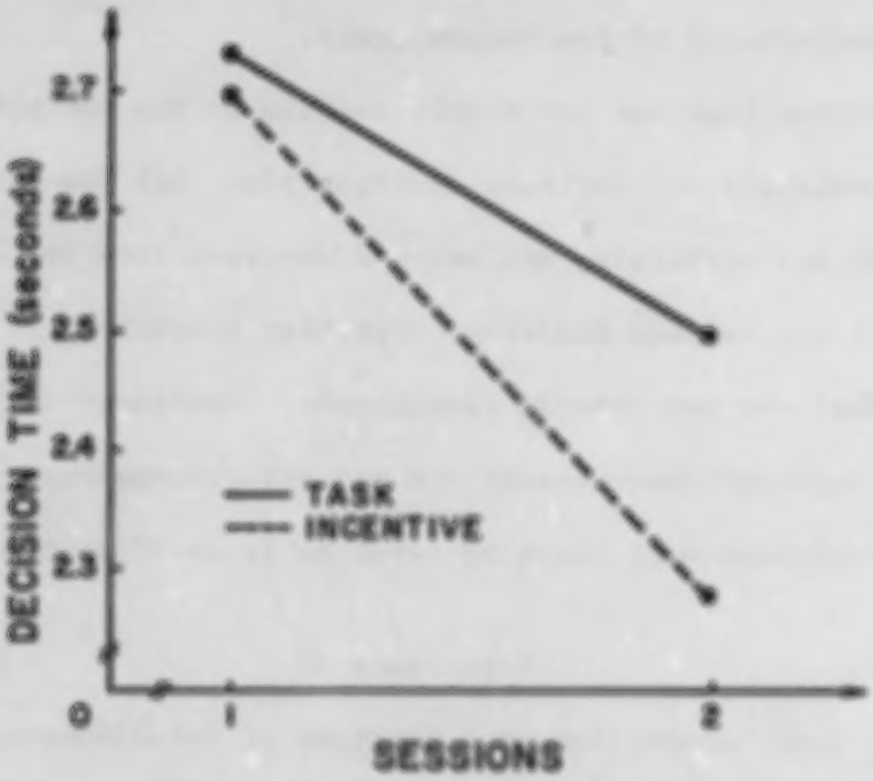
	Task Orientation (T-T)			Incentive Orientation (T-I)		
	FF	8-Side	16-Side	FF	8-Side	16-Side
Low	-.16	-.20	-.19	-.42	-.45	-.21
Medium	+.01	-.40	-.21	-.20	-.39	-.33
High	-.16	-.25	-.54	-.31	-.85	-.59

[1] Minus sign indicates a decrease in decision time from Session 1 to Session 2.

the different intelligence levels independent of the slight motivation x session effects (p = .07) illustrated in Figure 7. Further, the correlations between certainty and decision time (r = +.10) and between accuracy and decision time (r = +.26) were nonsignificant.

Figure 7

Mean Decision Time as a Function of Motivation and Practice



Conclusions

These findings may be summarized as follows:

1. Incentive motivation was associated with significant improvement in recognition accuracy and these effects are consistent over all levels of complexity.

2. Observer uncertainty increases as the stimuli become more complex.

3. Incentive motivation was generally associated with both increased accuracy and subjective certainty for the group, but correlation analysis indicated the individual *S*s ability to evaluate his performance did not

improve under these conditions. The increase in subjective certainty, therefore, probably represents the impact of the desirability of outcome on perceptual cognitive processes (27,35).

4. Intelligence level is an important factor determining baseline recognition performance, i.e., the amount of information processed by the individual. Incentive motivation exerted a facilitating effect on the performance of Ss in each of the Low and High intelligence groups, but did not modify the performance of the Medium group.

5. Decision time was not highly related to the motivational conditions. Increased complexity did increase decision time, but the low correlation between decision time and certainty, and between decision time and accuracy suggests these indices are tapping different cognitive processes, or an interaction of processes, that are not clearly specifiable. Certainly it is clear that decision time and confidence levels are not interchangeable with accuracy as indices of performance or learning level as is so often the assumed (80).

Experiment II

Form Recognition as a Function of Intelligence, Form Parameter and Perception Time

Introduction

The previous experiment raised a number of important questions requiring further investigation. The increase in perceptual efficiency associated with incentive motivation, and the form of interactive effects between incentive motivation and intelligence, and incentive conditions and complexity, were unexpected and of both theoretical and practical importance. Of most immediate relevance to the purposes of this study, however, were the highly significant differences in perceptual efficiency associated with the different levels of intelligence. Several perceptual theorists (1,21,22) have emphasized that object or shape perception depends upon simultaneous utilization of the various dimensional attributes of the forms; i.e., axial rotation, elongation, compactness, areal symmetry, redundancy, etc. Differences in form recognition accuracy attributable to intellectual level, therefore, may be a function of either the tendency for the dull children to respond to dimensions of the forms that have less "critical validity" for differentiation and recognition (e.g., area) or of the inability of these children to utilize combinations of shape cues (perceptual integration) in discriminating one complex form from another. The primary purpose of the following investigation was to determine whether or not children of low, medium and bright intellectual level vary in the tendency to utilize particular object/form dimensions in the discrimination-recognition process.

If intelligence is conceptualized as the capability for assimilating and utilizing environmental information, then the baseline differences in perceptual efficiency found in the previous study would be expected. Further, the increase in perceptual efficiency under incentive motivation suggests that incentive motivation results in a reduction of assimilation of cues *irrelevant* to form recognition. The relatively low perceptual efficiency characterizing the Low intelligence children, then, may well have been a function of attention to irrelevant, particularly extra display, aspects of the total stimulus situation. Observational data indicated these children tended to be more "distractable" and responsive to non-task elements of the laboratory. If the lack of capacity to maintain task centeredness was characteristic of the Low intelligence children, the relatively lower perceptual efficiency was a function of restriction on "encounters" with the stimulus and/or time for processing the visual information. Recognition accuracy of the Low intellectual group, then, may be improved by permitting more time (and/or more perceptual encounters) for object discrimination.

In view of these considerations, an experiment was designed to answer two questions: 1) What is the relationship between intellectual level and efficiency of utilization of the different parameters of form in the discrimination process, and 2) What is the relationship between intelligence and utilization of these parameters under tachistoscopic as compared to non-tachistoscopic (scanning) conditions.

Method

Subjects. A total of 48 fifth grade children served as subjects. The subjects were divided into three intelligence level groups (Low = 79-90 IQ; Middle = 105-118 IQ; and High = 119-139 IQ) on the basis of scores on the Pitner Non-Verbal Test of Intelligence. Twenty-six boys and 22 girls, all with normal vision, participated in the study.

Stimulus Material[1]. Randomly generated forms (cf. 1) were used for stimuli. All figures were equated for area (1.8 sq. in.). Forms were so constructed that variations along several dimensions could be obtained. The dimensions selected for study were:

1. Axial rotation - defined as the angle, relative to the vertical, of a line connecting the bisection of the maximum extents of the upper and lower hemispheres of the shape.

2. Elongation - the ratio of the maximum horizontal and vertical extents.

3. Areal symmetry - defined as the statistical variance of the areas comprising the four quadrants of a figure.

4. Compactness - defined as the sum of the deviations in line length from the length of a side for a regular polygon for a given number of sides.

5. Complexity - defined by the number sides in the closed figure.

---

[1] Appreciation is extended to Dr. Donald Brown, Purdue University, for use of these materials.

Problems were constructed by pairing figures that were matched for number of sides (4,8,12,16) and for one of the dimensions (e.g., elongation). Figures were considered matched when the differences between the relevant dimensions in the two figures did not exceed 5%. One figure of each pair was designated as the "different" figure. A problem display was constructed by photographing the "different" figure in combination with 5 instances of the other figures in the pair. The position of the "different" figure was randomly assigned to one of the six possible positions on the display. For this study, 64 such problems were constructed and divided into two problem-sets of 32 slides each. Within each problem-set, there were eight problems at each of the four levels of sides, and two slides for each of the 4 stimulus dimensions within each sidedness level. Sample problems are illustrated in Figure 8 and the list of stimuli and positions for the total experimental series are presented in Appendix C, Table 1.

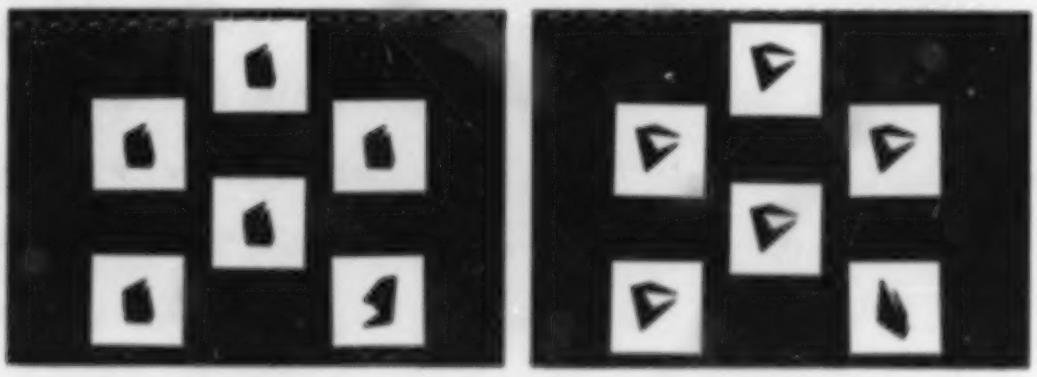
Task Requirements. The subjects were seated directly in front of the response board (Figure 9) which was 8 ft. from the screen. The experiment was conducted under Task-oriented motivational conditions for all *S*s. *S* was told that the experiment had nothing to do with school work but that he was to "try to do his best." *S*'s task was to identify the "different" stimulus in each display and then to indicate its position by pressing the appropriate response button.

Methods of Presentation. Under tachistoscopic presentation (Method A), each display was flashed on the screen for .2 of a sec. *S*s were asked to press the button which corresponded to the position of the "different" figure on the screen. The subject's choice response and response latency in milliseconds were recorded for each trial.

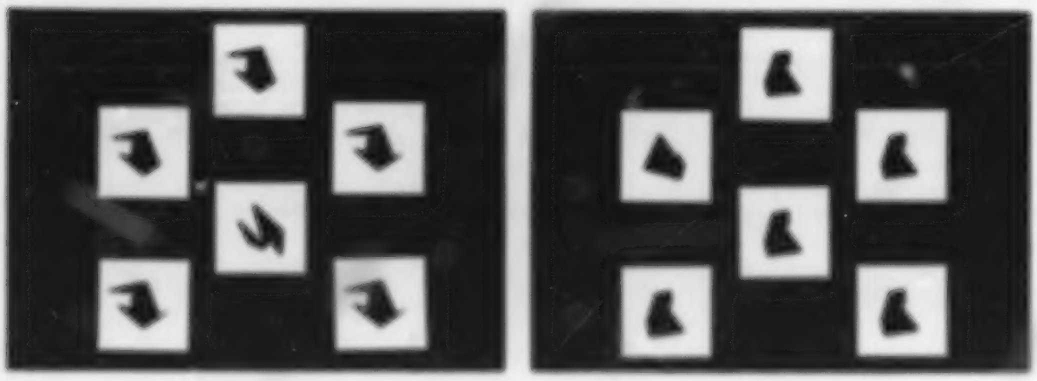
The scanning procedure (Method B) consisted of presenting the visual display and permitting the subject as much time as necessary to select the

Figure 8

Representative Visual Display for Complex Form Recognition: Study II



Elongation Compactness



Rotation Symmetry

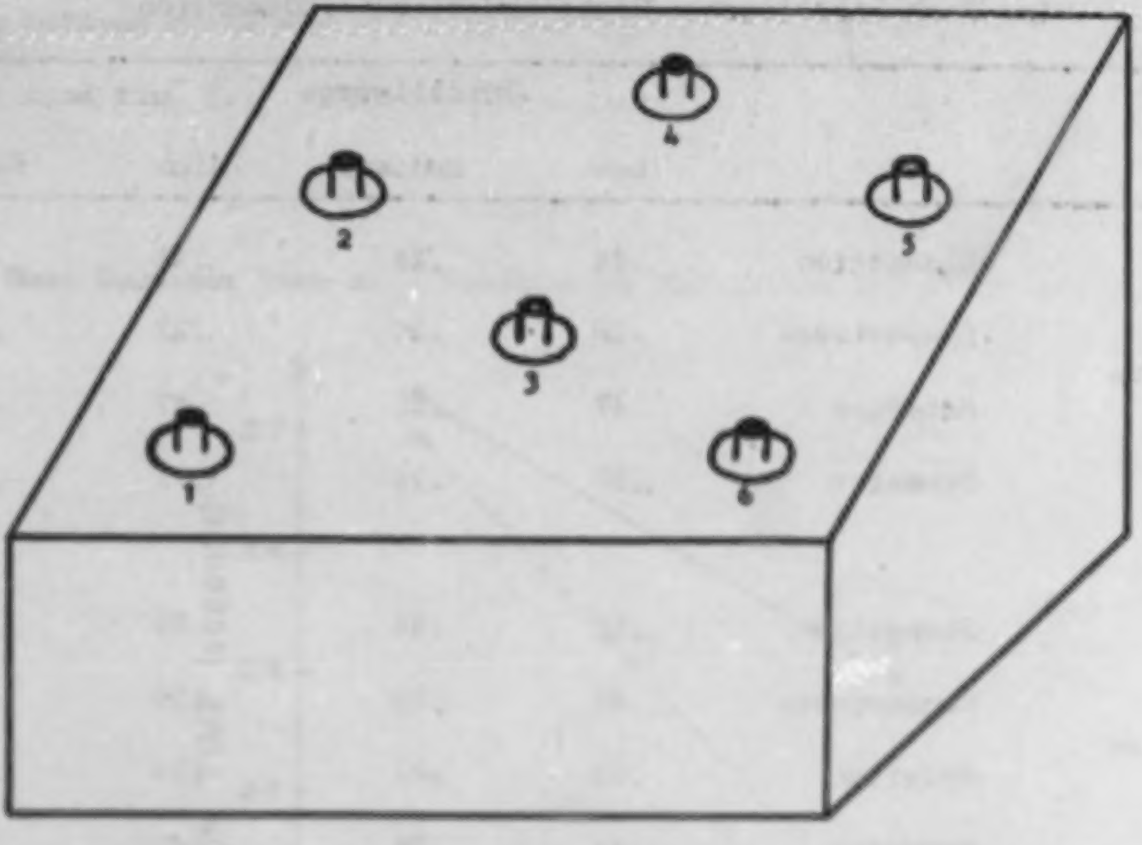
proper response. Response latency (i.e., time between stimulus presentation and response) and errors were recorded on each trial for each subject.

Procedure. With the exception of presentation methods described above, the procedure was identical for all *S*s. Following a familiarization period and practice recognition trials, *S*s were introduced to the appropriate test task. In each case a warning signal (light) was presented in the center of the screen 4 sec. prior to stimulus presentation. The subject was instructed to push the button on the response board corresponding in location to the "different" stimulus as it appeared in the visual display.

One-half of the *S*s was randomly assigned to the tachistoscopic presentation (Method A) first, and the scanning procedure second; whereas the

Figure 9

Response Arrangement for Complex Form Recognition: Study II



The numbers did not appear on the response board, they were included for illustrative purposes

(See Index Table)

order of tasks was reversed for the remaining half of the *S*s. Problem sets were also balanced within the order and method conditions; i.e., one half of the *S*s who had Method A first were administered Set 1, and the remaining *S*s received Set 2.

Results

Tachistoscopic Presentation.

Recognition Error: Table 6 presents the mean number of errors of recognition of forms for each intellectual level, on each of the dimensions and level of sidedness. Table 3, Appendix C, presents the analysis of variance summary of these data. Although intelligence level did not prove

Table 6

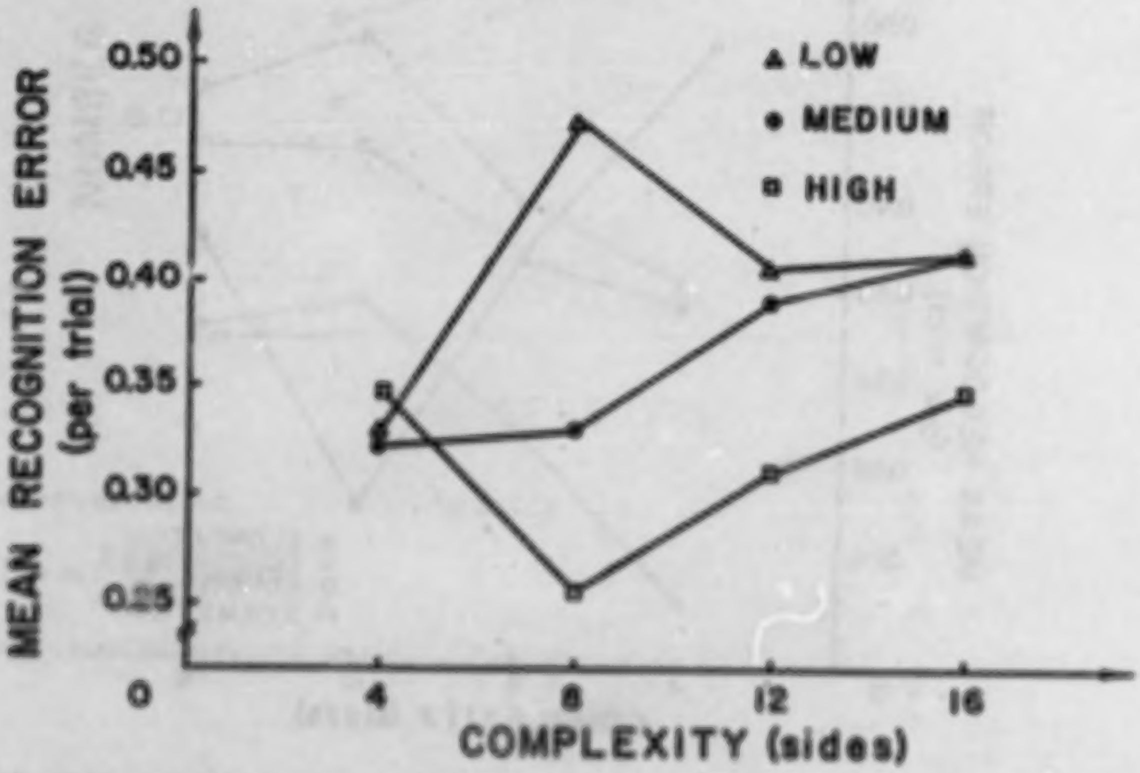
Mean Recognition Error Under Tachistoscopic Presentation for Each Intelligence Group and Stimulus Dimension

		Intelligence			
		Low	Medium	High	Mean
4 - Side	Elongation	.34	.28	.41	.34
	Compactness	.16	.16	.22	.18
	Rotation	.47	.50	.47	.48
	Symmetry	.38	.38	.31	.35
8 - Side	Elongation	.50	.38	.25	.38
	Compactness	.44	.19	.19	.27
	Rotation	.53	.41	.19	.38
	Symmetry	.44	.38	.41	.41
12 - Side	Elongation	.22	.34	.13	.73
	Compactness	.41	.31	.31	.34
	Rotation	.41	.47	.41	.43
	Symmetry	.59	.44	.41	.48
16 - Side	Elongation	.31	.41	.41	.37
	Compactness	.34	.38	.25	.32
	Rotation	.44	.38	.47	.43
	Symmetry	.56	.50	.28	.45
Mean		.41	.37	.32	

to be a significant main effect, the intelligence x sides interaction was statistically reliable ($F = 2.36$; df = 6,108; $p = < .05$). Figure 10 indicates the significant interaction is due primarily to the difference between the Medium and Low intellectual groups on the 8-sided figure. The High intelligence group maintained its superiority over the other groups as the stimuli increased in complexity (number of sides).

Figure 10

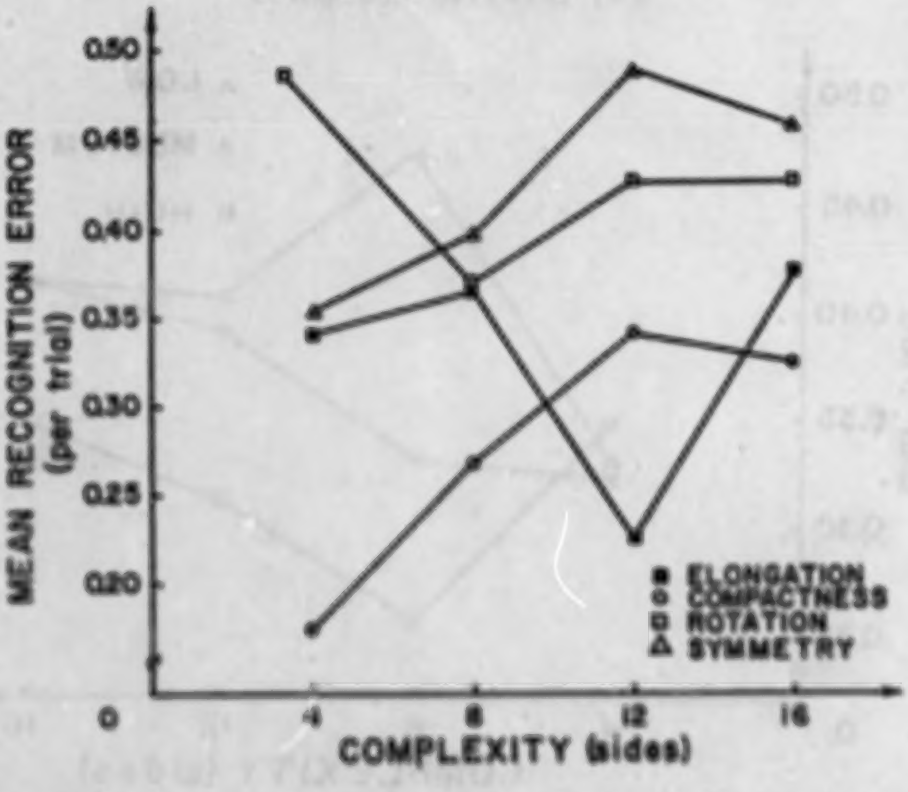
Mean Recognition Error as a Function of Complexity and Intelligence Level



Dimensions proved to be a highly significant ($p = < .001$) source of variation. Reference to Table 3, Appendix C, presents the order of discrimination difficulty as a function of the form dimensions. Similarity in the "compactness" of form contributed most to difficulty in discrimination, with "elongation," "symmetry," and "rotation" contributing increasingly less to difficulty level. As indicated in Table 2, Appendix C, the effect of a particular dimension of similarity varies also as a function of complexity ($p = < .001$). Figure 11 illustrates the nature of this effect and suggests that only the "rotation" and "elongation" parameters contribute differentially to discrimination efficiency as a function of the number of "sides" to the stimulus configuration.

Figure 11

Mean Recognition Error as a Function of Complexity and Stimulus Dimension



Decision Time: Table 7 presents the mean decision time scores for each intelligence group and stimulus parameter under tachistoscopic presentation conditions. Analysis of variance of these data (Table 4, Appendix C) yielded statistically reliable effects only for sides ($p = < .01$) and dimensions ($p = < .05$). These findings are illustrated in Figure 12, p. 32. Intelligence did not prove to be significantly related to decision time either as a main effect, or as a contributing interactive factor. Thus,

Table 7

Mean Decision Time as a Function of Intelligence and Stimulus Dimensions Under Tachistoscopic Presentation (Method A)

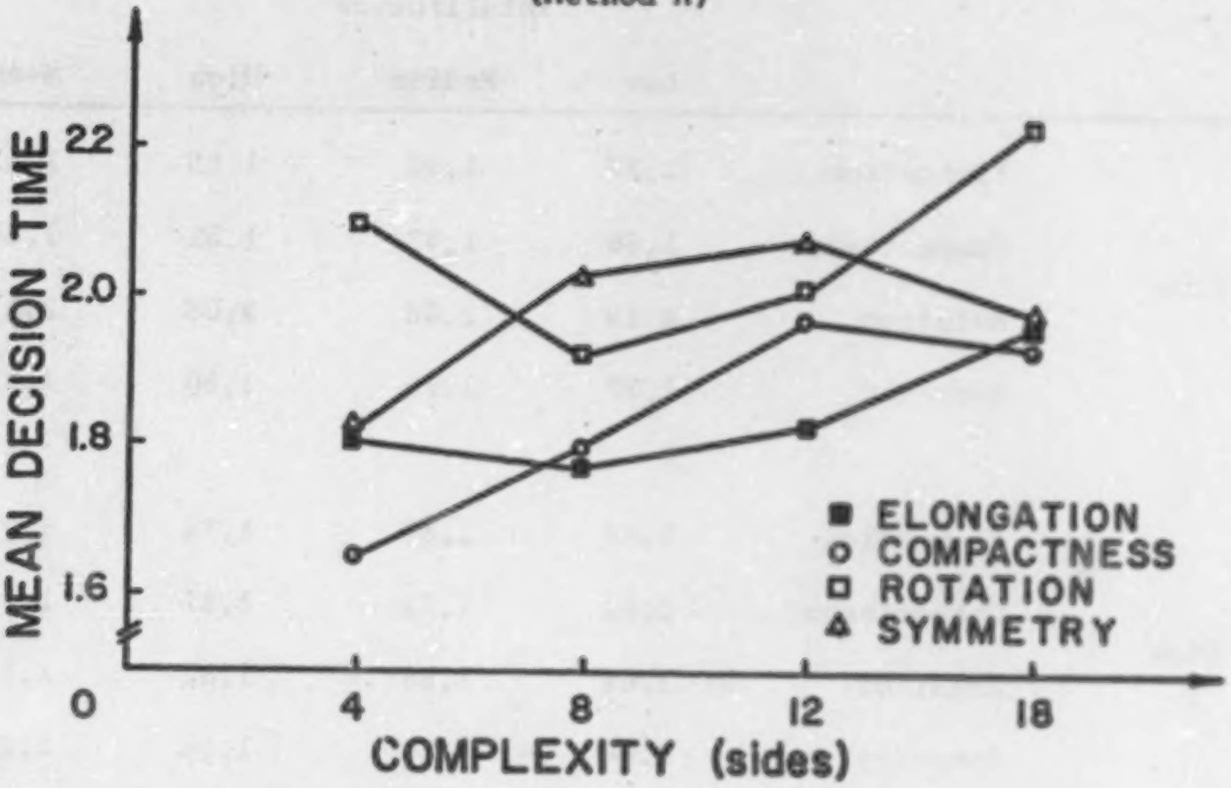
		Intelligence			
		Low	Medium	High	Mean
4 - Side	Elongation	1.77	1.99	1.69	1.82
	Compactness	1.60	1.87	1.51	1.66
	Rotation	2.19	2.06	2.08	2.11
	Symmetry	1.87	1.79	1.80	1.82
8 - Side	Elongation	1.69	1.89	1.74	1.77
	Compactness	2.01	1.72	1.67	1.80
	Rotation	2.08	1.88	1.82	1.92
	Symmetry	2.08	2.10	1.94	2.04
12 - Side	Elongation	1.70	1.84	1.94	1.83
	Compactness	1.83	1.93	2.16	1.97
	Rotation	1.83	2.21	1.99	2.01
	Symmetry	2.11	2.31	1.84	2.09
16 - Side	Elongation	1.79	1.96	2.13	1.96
	Compactness	1.69	2.15	1.98	1.94
	Rotation	2.16	2.01	2.53	2.23
	Symmetry	2.04	2.07	1.78	1.96
Mean		1.90	1.99	1.91	

Figure 12

Mean Decision Time as a Function of Complexity and

Stimulus Dimension

(Method A)



response impulsivity cannot account for the difference in recognition errors associated with intelligence found in the prior analysis.

Scanning Method. Decision time was the primary measure of recognition efficiency under the scanning condition (Method B). Table 8 presents the mean decision time for forms at each intellectual level for each of the form parameters. Table 2, Appendix C, presents the summary analysis of variance of these data. Intelligence level proved to be a significant main effect ($p = < .05$) but did not contribute as a differential factor to recognition efficiency in conjunction with any of the other experimental variables. Stimulus dimensions were again a highly reliable factor ($p = < .001$) in recognition difficulty. The order of discrimination difficulty as a function of the different parameters of form (Appendix C,

Table 8

Mean Decision Time as a Function of Intelligence and Stimulus Dimensions Under the Scanning Condition

		Intelligence			
		Low	Medium	High	Mean
4 - Side	Elongation	2.83	2.37	2.06	2.42
	Compactness	2.41	1.96	1.70	2.02
	Rotation	3.25	2.79	2.22	2.75
	Symmetry	2.85	2.26	1.96	2.35
8 - Side	Elongation	2.63	2.14	2.06	2.27
	Compactness	2.54	1.86	1.74	2.04
	Rotation	2.77	2.58	1.78	2.37
	Symmetry	2.94	2.23	1.89	2.35
12 - Side	Elongation	2.62	2.24	1.87	2.24
	Compactness	3.03	2.20	1.85	2.36
	Rotation	2.82	2.83	2.13	2.59
	Symmetry	2.79	2.39	2.21	2.46
16 - Side	Elongation	3.34	2.71	2.18	2.74
	Compactness	2.77	2.47	1.95	2.39
	Rotation	2.88	2.33	2.32	2.51
	Symmetry	2.92	2.24	2.36	2.50
Mean		2.83	2.35	2.02	

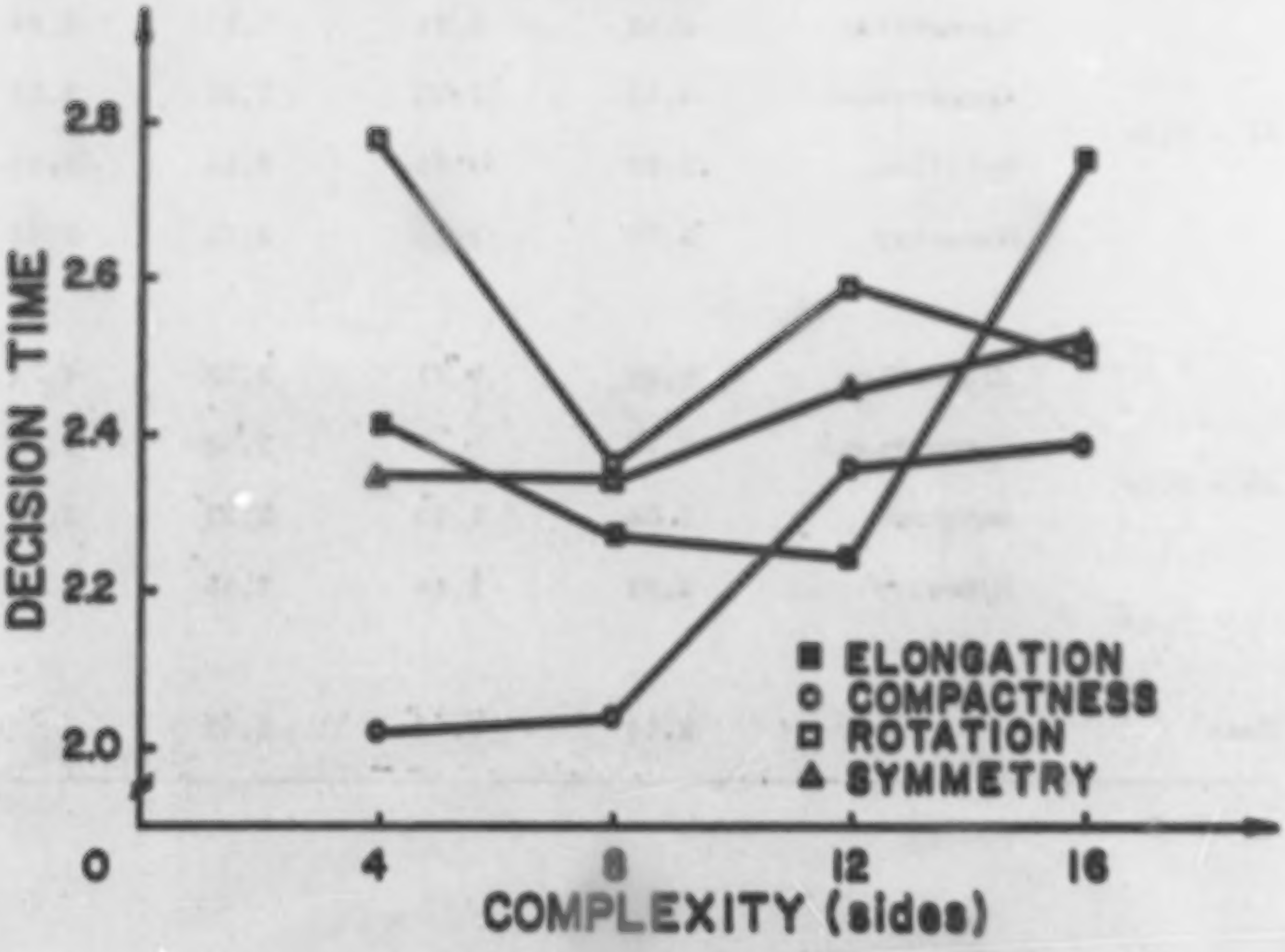
Table 5) was similar to that found under tachistoscopic presentation. "Compactness" contributed most to discrimination difficulty whereas elongation, symmetry, and rotation contributed relatively less in that order. As indicated in Table 2, Appendix C, the interaction of level of complexity (sides) and stimulus parameters was again significant (p = < .05). Figure 13 illustrates the fact that this effect is due primarily to two factors: 1) at the lowest level of complexity (4 sides), compactness contributed relatively little to discrimination difficulty, whereas rotation increased discrimination difficulty of four sided forms; and 2) elongation contributed an unusual amount to the difficulty of discrimination of the more complex (16 sided) forms.

Figure 13

Mean Decision Time as a Function of Complexity

and Stimulus Dimension

(Method B)



Practice Effects. Analysis of the practice (trials) effects for each method of presentation (See Appendix C, Table 6) yielded significant effects for the trials variable under both conditions ($p = < .01$). However, the differential intelligence levels benefited equally from the practice effects inherent in both experimental procedures.

Conclusions

The following conclusions appear warranted on the basis of these data:

1. Level of intelligence is related to accuracy of form recognition independent of the particular parameter of the form that is criterial for discrimination.

2. The dimension (parameter) of form that is criterial for recognition differentially influences recognition accuracy. "Rotation" (orientation) of the form conveys most information, while "compactness" of form contributes relatively little to recognition accuracy.

3. Generally, the opportunity for increased perception time (scanning procedure) improves recognition accuracy and is more sensitive to differences in intelligence, but the basis for form discrimination (i.e., parameter effect) does not vary with the two methods of presentation.

4. In addition, form parameters, but not intelligence, were associated with decision time in form recognition under the non-scanning conditions.

Experiment III

Effects of Incentive Motivation on Perceptual Span

Introduction

The purpose of the present study was to determine if incentive motivation differentially modifies spatial localization accuracy for children of Low, Medium and High intelligence levels. The empirical support for the hypothesis that motivational arousal produces a reduction in both range and breadth of cue utilization is extensive. However, the operational definition of "range and breadth of cue utilization" by different investigators has varied considerably. The number of task relevant cues utilized (12,13), accuracy of pattern recognition (cf. 33,35), and utilization of incidental cues (2,36,39) represent the most frequent dependent variable measures. Relatively little systematic research has been conducted on the effect of motivation on modification of the range or extensity of perceptual field (4,14,61). Evidence from both clinical and experimental research indicates, however, that motivation or drive may have such effect on the visual perceptual process. Granger (29,30) recently presented nine clinical cases in which extreme emotional conflict was linked with anomalies of visual functioning such as tunnel vision. Less dramatic, perhaps, but just as suggestive are the findings of Calloway and Dembo (16) among others (27,42,61,67) which indicate that motivation arousal may reduce assimilation of cues necessary for distance and size perception. Recent evidence from neurophysiological research (8) suggests also that drive increases produce an actual "centering of attention" on objects in the center of visual field with consequent loss of informational input from the periphery. The implication to be drawn from these data is that incentive motivation generally reduces informational input from the environment and thus modifies apparent size and apparent distance of objects in the visual field. If such is the case one would expect, as a minimal perceptual distortion, errors of localization of objects in the visual field.

The purposes of this experiment were: 1) to determine if incentive motivation resulted in a significant decrease in accuracy of localization of stimuli in complex visual display, and 2) to determine if motivation had a differential effect on perceptual localization accuracy of bright, average, and dull children.

Method

Subjects. The sample consisted of 42 boys and 30 girls in the three intellectual groups described in detail in Chapter 2, p. 7.

Stimulus Material. Two types of standard stimuli were constructed; one series consisted of familiar geometric forms, and a second series of selected letters of the alphabet. Standard stimuli in the form series (F) were cut from 1/8th in. plasterboard, painted flat black, and had a pin attached to the back. Standard stimuli in the letter series (L) were constructed in a similar manner with the exception that the cut-outs consisted of black block letters painted on white plasterboard squares.

Stimuli (comparison) appearing on each visual display were randomly selected. Six displays within each of the form and letter series had six stimuli, while six displays contained 8 stimuli. Placement of the stimuli on each slide was determined as follows: a) the area of the slide was divided into three equidistant concentric circles about the center (center, intermediate, peripheral rings) so that the projected rings would subtend 1°, 2.5°, and 6° angles respectively; b) the 8 (or 6) stimuli were randomly placed on these rings with the restriction that only two of the three circles were to be used on any one slide, and that one-half of the stimuli for a slide would appear on each of the two rings. All combinations of ring pairings were equally represented in the experimental series.

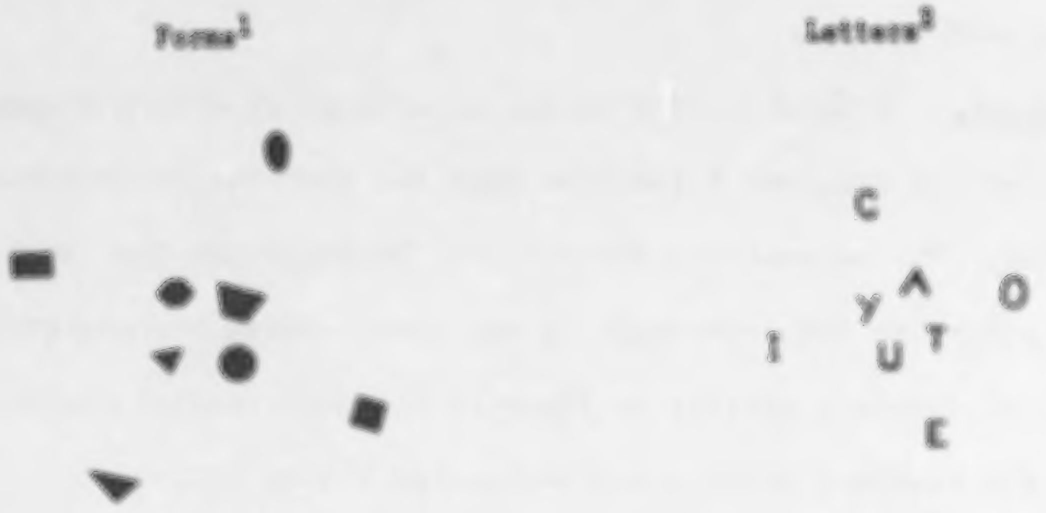
Order and placement of the target (comparison) stimuli were achieved by combining a random series of the 8 (or 6) standard stimuli, with the restriction that each stimulus appear three times; and the random series of three circles such that each appeared 24 times; with the random series of the 4 quadrants with the restriction that each appear 6 times. These three series were then combined so that each of 8 (or 6) standard stimuli appeared in the "correct" response position exactly once on each circle, but never twice in any one quadrant. In order to meet these randomization conditions each of the 12 slides within each set was presented twice, i.e., to provide a total of 24 different target location tasks and 24 experimental trials for each of the F and L set of targets. Figure 14 presents sample displays from the experimental sets, while the complete target conditions for the total of 24 trials for each of the F and L sets are presented in Table 1, Appendix D.

Experimental Task. A small fixation point was mounted in the center of the screen and appeared 2 sec. prior to the presentation of the visual display. Ss sat in front of a response board consisting of a plasterboard rectangle obtaining three times the visual angle of the screen 8 ft. in front of them.

Prior to each trial, S was handed a standard stimulus. Following presentation of the signal-fixation light and exposure of the visual display for 200 msec, S was required to place the standard stimulus on the response board in a position corresponding to the location of the comparison stimulus in the visual display. Each standard stimulus was "located" on three trials; thus, each S had a total of 24 trials on each of the F and the L series.

Figure 14

Stimuli and Representative Visual Displays for Peripheral Localization


Forms[1] Letters[2]

[1] Stimuli on Center and Peripheral rings
[2] Stimuli on Center and Intermediate rings

Recording of Responses. A pin mounted on the back of the standard stimulus punctured the response sheet each time it was positioned on the board. E recorded the trial and session number beside each of these marks. Two measures of the dependent variable were used: a) the angular deviation between the observed and correct locations of the stimulus, and b) the difference in linear distance from the center between the observed and correct locations of the standard stimulus. A "constant" error score also was computed by algebraic summation (+ = error toward center) of the direction of linear deviation errors.

Motivational Conditions. The two motivational conditions described in detail in Chapter 2 were utilized. At the conclusion of Session 1, *S* was told he had done a good job and would be seen again in a few days. In Session 2 the same procedures were followed with the exception that incentive motivation (See Chapter 2, p. 10) was introduced prior to beginning the experimental task. *S*s in the incentive motivation group (T - I) were seen for Session 2 only after all *S*s in the task oriented group (T - T) had completed both sessions.

Procedure. *E* introduced *S* to the experiment by giving a general description of the task and a reminder that the task was unconnected with school work. The appropriate motivational instructions then were given. Prior to beginning the experiment, *S* was administered six practice trials using visual displays similar to those in the experimental series. *E* handed *S* one of the standard stimuli and instructed him as follows:

> "Look at the warning light closely when it appears on the screen. Keep watching it until the picture is flashed. When you see the picture look for the form (letter) that looks just like this one. Then stick the cut-out on the response board in exactly the same position as it appeared on the screen."

If there were no further questions *E* proceeded with the experimental trials. The 24 trials in the F trial series were followed immediately by the 24 trial L series.

Results

The primary experimental questions of this study are concerned with the effects of motivation on perceptual localization accuracy and the differential influence of motivation on localization of objects in the different field positions. As in the previous study, incentive motivation was introduced in Session 2 and the consequences of motivation on performance must be evaluated relative to any practice (Session) effects.

Angular Error.

Form Set: Table 9 presents the mean and standard deviation of Angular errors for the Form and Letter sets as a function of intelligence, session, and motivation. Analysis of variance of the data upon which these means are based is found in Appendix D, Table 2. Neither the motivation x session, nor the motivation x session x position interactions were statistically significant. The significant reduction in angular error in Session 2 as compared to Session 1 ($p = < .01$) and the motivation x intelligence x position interaction ($p = < .05$), also must be interpreted in light of the non-significant motivation x session interaction. As indicated in Table 9 and Figure 15, in the "low" intelligence group incentive motivation (T-I) is associated with greater accuracy than is task motivation (T-T) in localizing center and intermediate target forms, but with less accuracy on the peripheral forms.

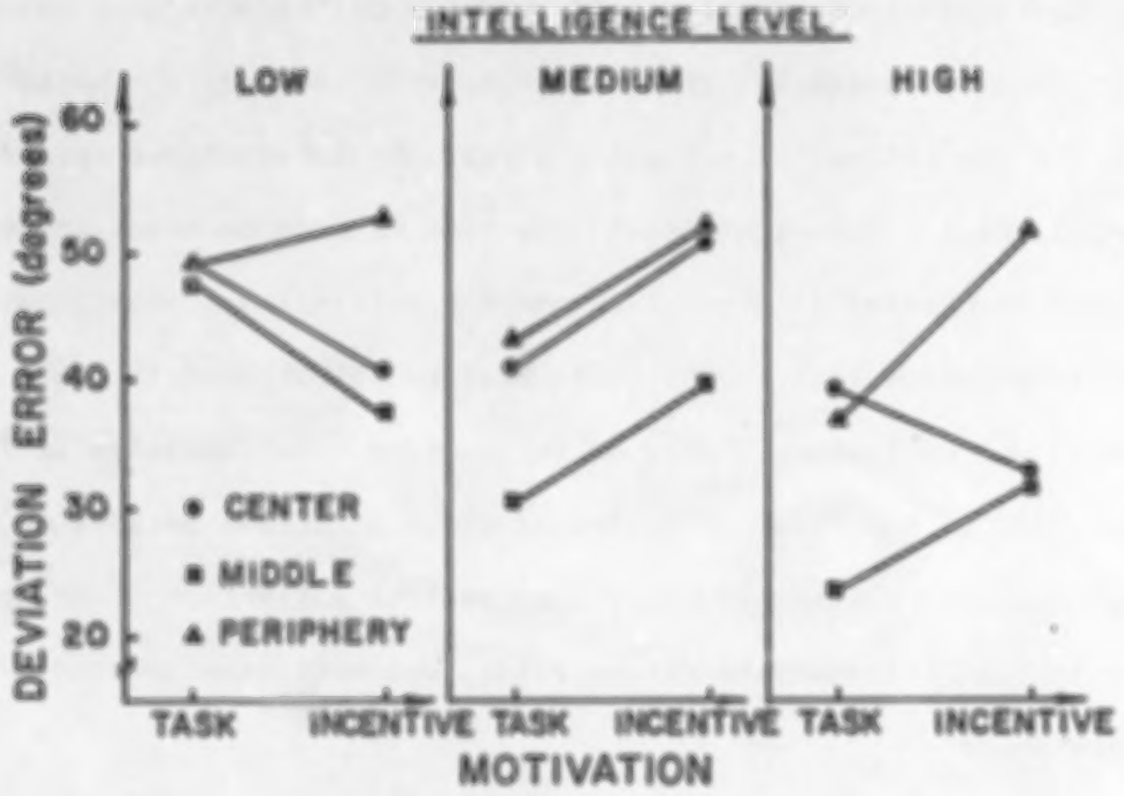
Table 9

Mean Error of Angular Placement for the Form and Letter Sets as a Function of Intelligence, Motivation, and Practice

	Task Orientation (T-T)		Incentive Orientation (T-I)	
	Session 1	Session 2	Session 1	Session 2
		A. Form Set		
Low	47.00°	46.00°	51.00°	43.00°
Medium	42.00°	50.00°	35.00°	45.00°
High	36.00°	43.00°	31.00°	36.00°
		B. Letter Set		
Low	38.50°	39.50°	44.00°	34.00°
Medium	30.00°	26.00°	36.00°	35.00°
High	28.00°	24.00°	35.00°	23.00°

Figure 15

Mean Angular Error for Forms as a Function of Intelligence, Motivation, and Stimulus Position

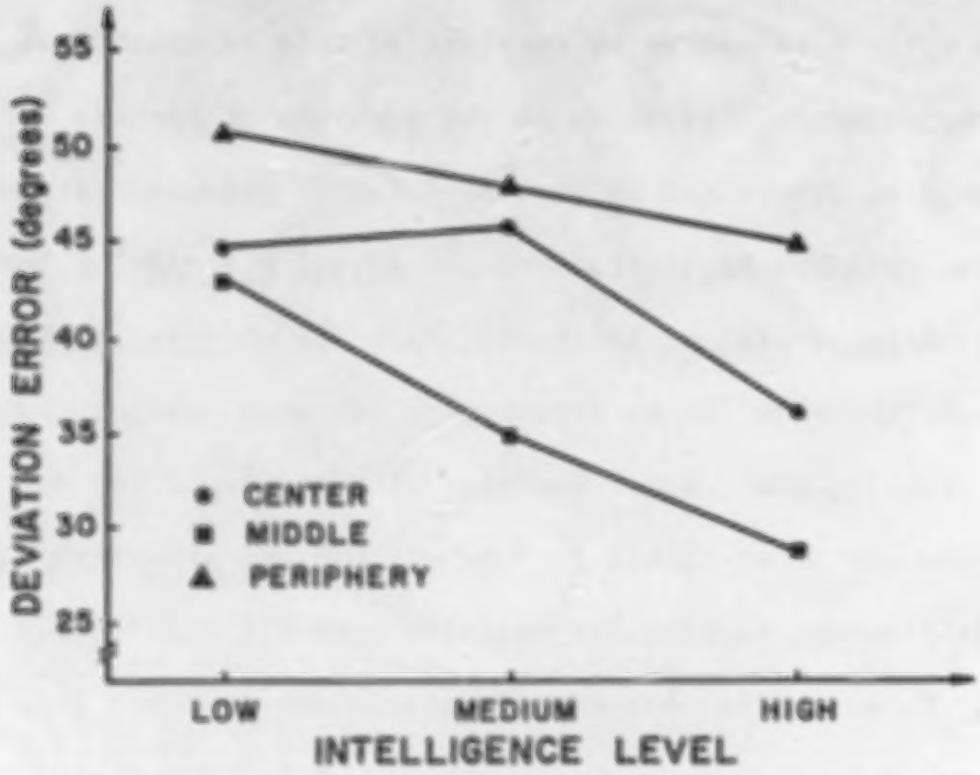


In the Medium intellectual group, T-I Ss manifested less accuracy than T-T Ss on all three stimulus positions; whereas in the High intelligence group, Ss under incentive motivation again performed more accurately than the task oriented Ss on center stimuli, but less so on intermediate and peripheral stimuli. Variation in performance between the two motivational groups, however, is primarily due to initial group differences and not to the effect of the "incentives" since the motivation x session interaction was not reliable.

Intelligence level differentially influenced localization accuracy for stimuli in the different field positions (IxP; p = .05) as is illustrated in Figure 16. Ss at all three intelligence levels tend to be most accurate for stimuli in the middle field position, with somewhat less accuracy for those stimuli on the central and peripheral rings. In addition, Ss in the

Figure 16

Mean Angular Error for Forms as a Function of Intelligence and Stimulus Position



High group do best on all positions, followed by Ss in the Medium and Low intellectual groups respectively. The facilitating effects of the High intellectual level are most apparent for the stimuli in the intermediate field position. Generally the higher the intelligence, the higher the perceptual efficiency (p = < .05) on this task.

Letter Set: The mean angular deviation errors associated with the Letter Set are summarized in Part B of Table 9. As indicated in the summary analysis of variance (Table 2, Appendix D) none of the relevant interactions approach statistical significance. However, the main effects of intelligence, sessions, and position, were highly significant sources of variation as was the case in the previous analysis of the Form set. The fact that angular localization error was much smaller for the letters suggests greater perceptual "constancy" for letters which could account for the failure of the relatively low level of incentive motivation to greatly modify perceptual accuracy.

Linear Error.

Form Set: A second major question of this experiment was the effect of the experimental variables on the accuracy of spatial localization of stimuli as determined by errors of linear placement of the stimuli. Linear error was obtained by subtracting the *actual distance* of the comparison stimulus, from the center of the field, from the *observed distance*. Table 10 presents the mean linear error score for each session, motivational condition and intelligence group. Analysis of variance of the data upon which these means are based (Table 3, Appendix D) indicates that the main effects of intelligence, session and position were all significant at below the .05 level. However, the only significant interaction was that between

Table 10

Mean Linear Error for the Form and Letter Sets as a Function of Intelligence, Motivation, and Practice

	Task Orientation (T-T)		Incentive Orientation (T-I)	
	Session 1	Session 2	Session 1	Session 2
		A. Form Set		
Low	1.73	1.57	1.48	1.40
Medium	1.35	1.32	1.65	1.48
High	1.32	1.30	1.36	1.26
		B. Letter Set		
Low	1.45	1.52	1.51	1.28
Medium	1.27	1.11	1.37	1.32
High	1.31	1.22	1.40	1.07

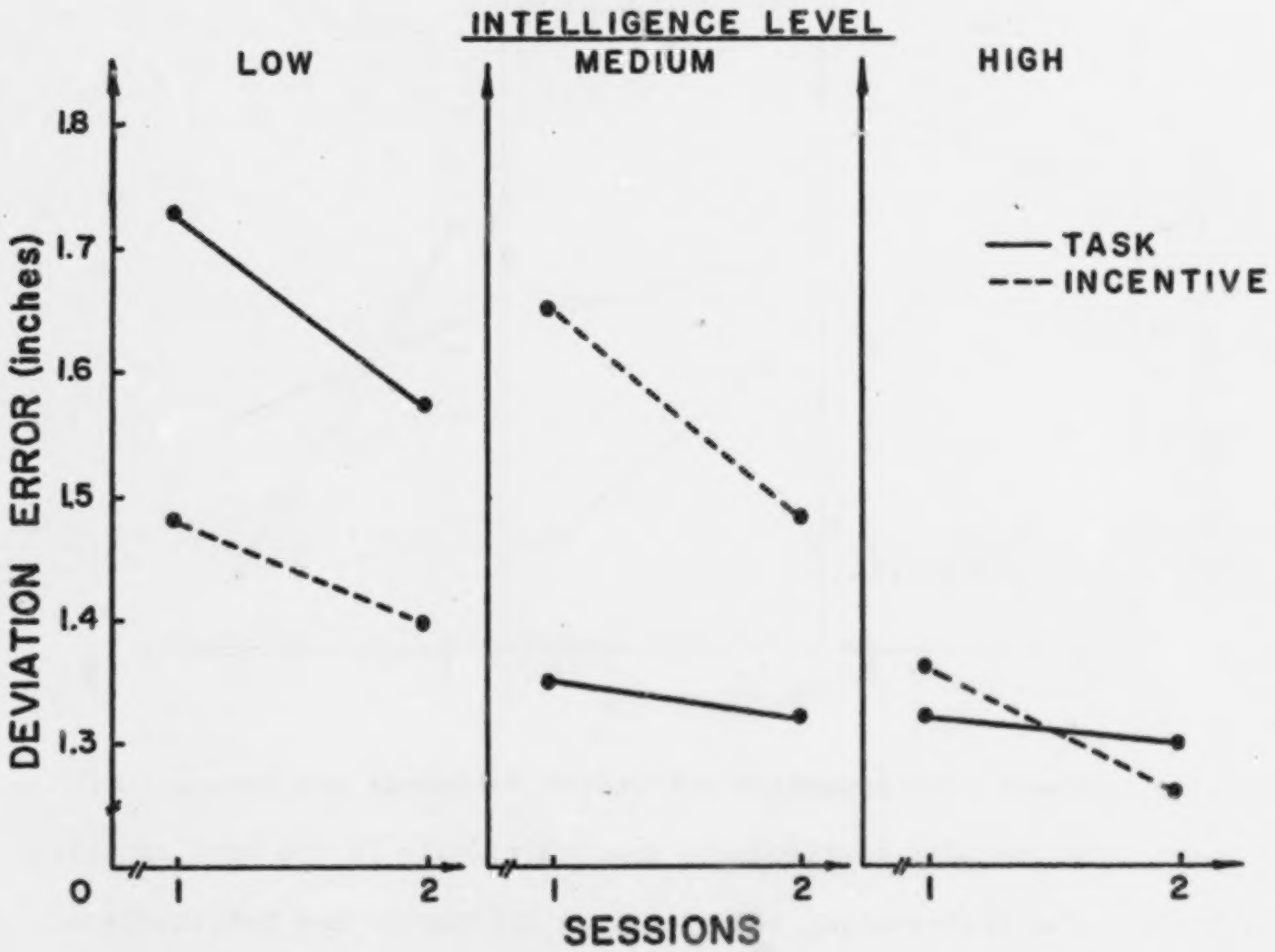
2

motivation and intelligence ($p = < .05$). Since the motivation x intelligence x session interaction was not statistically reliable it must be inferred that motivation x intelligence interaction is a reflection of the inequality of the matching of the two experimental groups. Figure 17 indicates these initial differences (Session 1) in performance of Ss randomly assigned to the two motivational conditions. Whether the obtained differences represent truly chance bias in random assignment or are an artifact of the particular experimental conditions (e.g., experimenter characteristics) can not be determined at this time.

Figure 17

Mean Linear Error for Forms as a Function of

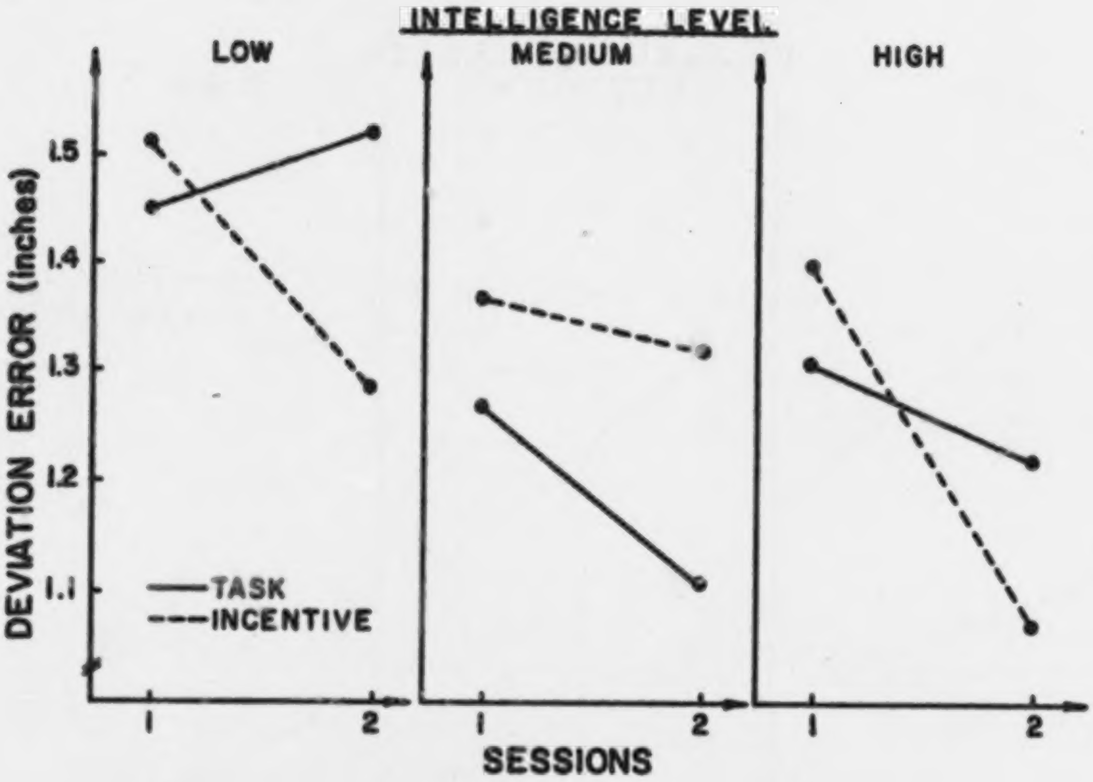
Intelligence, Motivation, and Practice



Letter Set: The analysis of variance of error data for the Letter set yielded somewhat different results than that for the Form set presented previously. Table 10 (Part B) presents the relevant means, and the analysis of variance is summarized in Appendix D, Table 3. The main effects of intelligence, sessions, and stimulus position again were significant at less than the .05 level. Further, incentive motivation exerted a differential effect on the perceptual accuracy of Ss at different intelligence levels above that associated with practice (I x M x S, $p = < .05$) as illustrated in Figure 18.

Figure 18

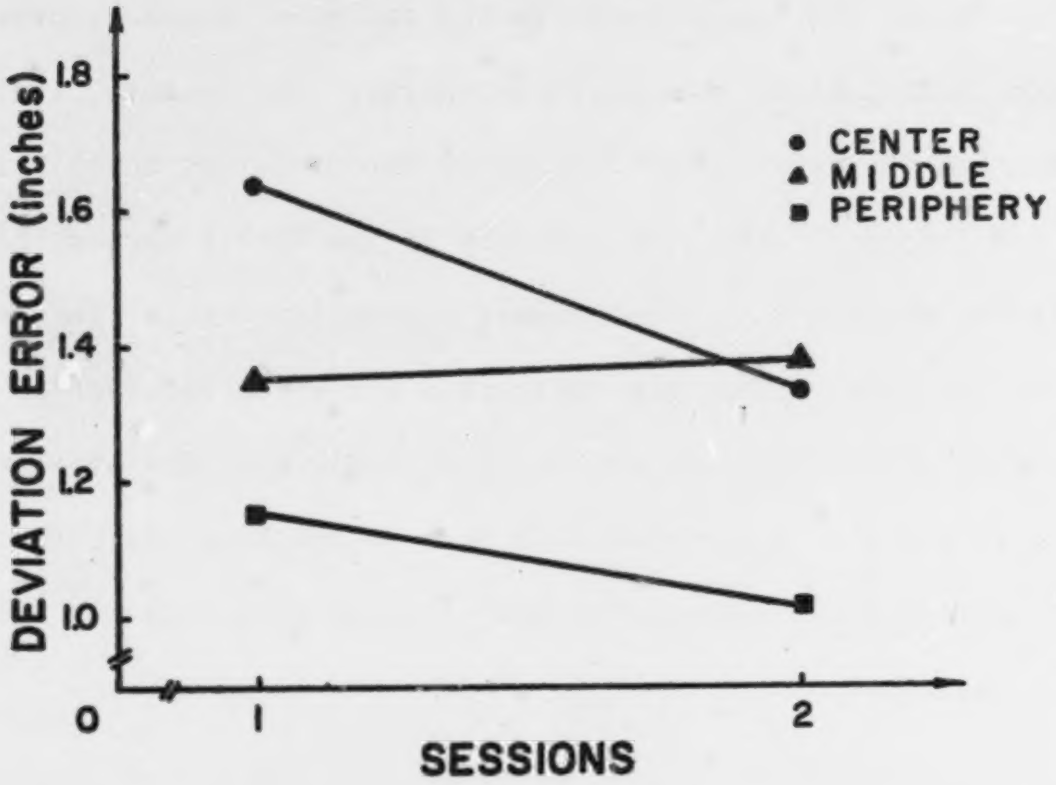
Mean Linear Error for Letters as a Function of Intelligence, Motivation, and Practice



These data indicate that incentive motivation increases the accuracy of the linear localization, particularly for individuals in the high intelligence group. The localization of stimuli on the center and intermediate rings of the display also proved to be more affected by practice (S x P, $p = < .05$) than do stimuli in the periphery (See Figure 19).

Figure 19

Mean Linear Error for Letters as a Function of Stimulus Position and Practice



The analysis of data on the effects of motivation on perceptual constriction as measured by linear and angular errors suggested a considerable degree of independence. Pearson-product moment correlations of the two variables, computed separately for the F and L series, within each intelligence group ranged from +.39 to +.31. These correlations are statistically significant beyond the .01 level, but the coefficient of determination (r^2) indicates that to a large extent the linear and angular displacement scores are independent measures of localization error. In view of this relative independence of the two error scores, it was thought a composite score, reflecting total localization error, might be a more sensitive indicator of the effects of the motivational and intelligence variables.

Angular and linear error scores each were transformed to Z-scores, summed and an analysis of variance completed for the F and L sets separately. Table 11 presents the mean Z-scores for each of the Form and Letter sets. As indicated in the analysis of variance summary presented in Appendix D, Table 4, this analysis did not contribute much additional information. While the trends noted in the analysis of the original scores are, perhaps, highlighted, no new trends emerge. For example, it is clear the differential influence of motivation at the different intellectual levels (I x M x S, $p = < .05$) operates only in the Letter series (Figure 20). While the motivation x intelligence x position interaction was significant for the Form series, the motivation x session interaction was not a statistically reliable effect (Appendix D, Table 4). Therefore, the triple interaction (I x M x P) associated with form recognition was a function of the baseline differences between the motivational groups as was the case in the earlier analysis.

Table 11

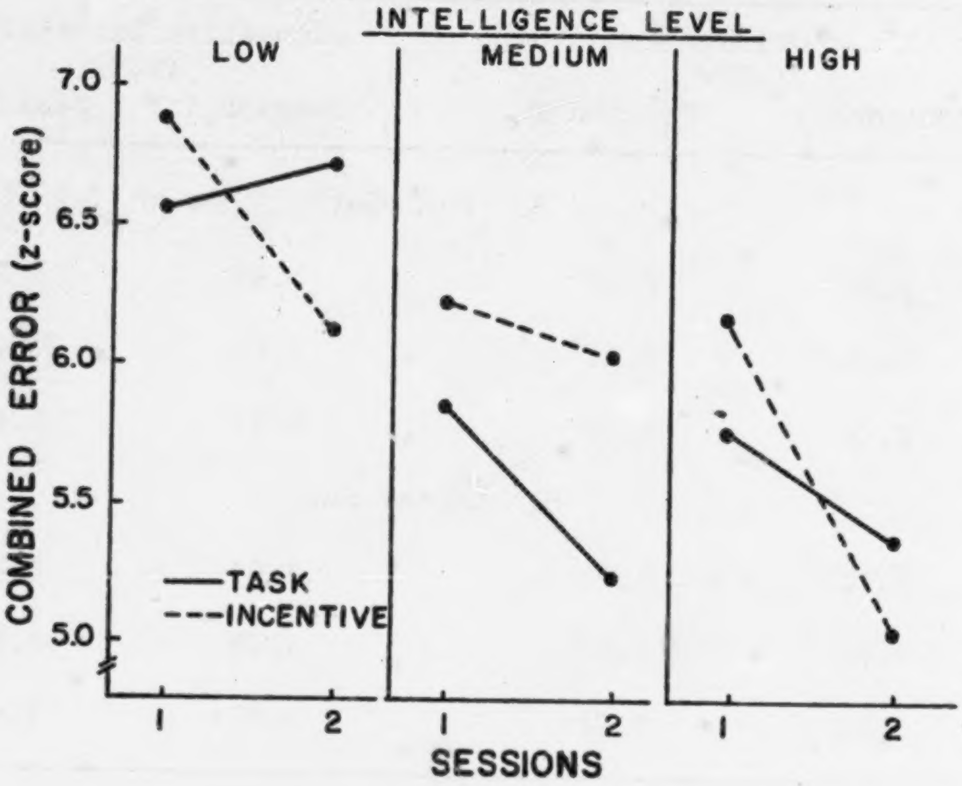
Mean Errors (Z-Scores) for Forms and Letters as a Function of Intelligence, Motivation, and Practice

	Task Orientation (T-T)		Incentive Orientation (T-I)	
	Session 1	Session 2	Session 1	Session 2
		A. Forms[1]		
Low	4.93	4.66	4.38	4.20
Medium	3.87	3.86	4.66	4.18
High	3.49	3.28	3.88	3.36
		B. Letters[1]		
Low	6.56	6.71	6.87	6.12
Medium	5.85	5.24	6.22	6.04
High	5.77	5.39	6.18	5.05

[1] Constants of 4 and 3 were added to the Form and Letter data respectively.

Figure 20

Mean Combined Error (Z-Scores) for Letters as a Function of Intelligence, Motivation, and Practice



Constant Error. The final question which may be answered by these data concerns the effects of the experimental conditions on the direction of errors of localization. In order to assess the "constant" errors in placement, linear deviation scores were summed algebraically; i.e., the error score was given a positive (+) sign if it was toward the center, and a minus sign (-) if the error was toward the periphery of the field. Table 12 presents the mean constant error in linear deviation for the different intellectual and motivational groups at each of the three stimulus positions. The analysis of variance of these data, for both the Form and Letter series, is presented in Table 5, Appendix D. No significant effects can be attributed to either the motivation x session x position, nor the motivation x intelligence x session interactions. However, in both the Form and Letter series there was a significant differential effect of motivation at the

Table 12

Mean Linear Constant Errors for Form and Letter Sets as a Function of Intelligence, Motivation, and Practice

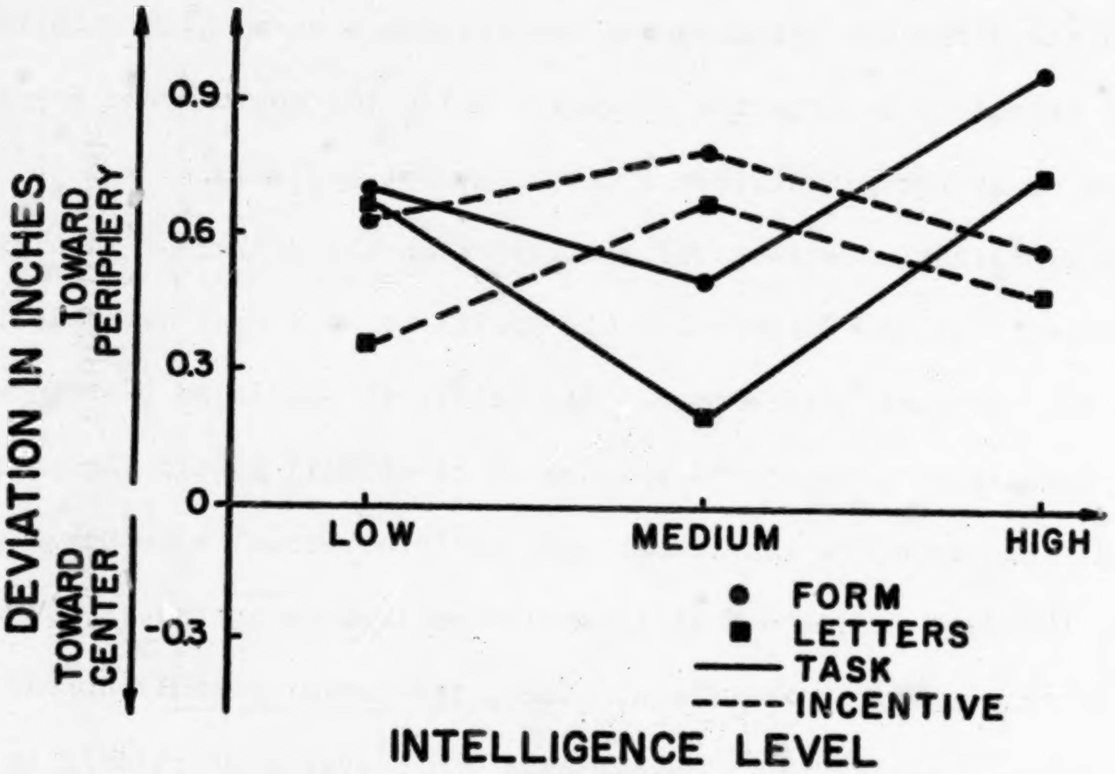
	Task Orientation (T-T)		Incentive Orientation (T-I)	
	Session 1	Session 2	Session 1	Session 2
		A. Form Set		
Low	3.71	3.59	3.49	3.24
Medium	3.36	3.16	3.75	3.61
High	3.78	3.72	3.51	3.42
		B. Letter Set		
Low	3.70	3.61	3.74	3.54
Medium	3.63	3.39	3.90	3.72
High	4.00	3.93	3.67	3.47

different levels of intelligence. Inspection of Figure 21 indicates the similarity of the effects for both the Form and Letter sets.

The Task-orientation subjects (T-T) in the High and Low intelligence groups exhibit a greater tendency to displace stimuli toward the periphery than do individuals under incentive motivation (T-I). Further, Ss in the Low and Middle intelligence groups show almost identical profiles for stimuli in the three positions with both groups having the greatest peripheral displacement for stimuli on the center ring, lesser error for stimuli on the middle, and a relatively slight displacement toward the center for stimuli on the peripheral ring. Ss in the High intelligence group show similar trends in the case of center and peripheral locations, but manifest a much greater error in locating targets on the intermediate ring.

Figure 21

Mean Constant Error for Form and Letter Sets as a Function of Intelligence and Motivation



Conclusions

These data would appear to warrant the following general conclusions:

1. Intellectual level was a statistically significant main effect on all the measures of localization accuracy except that concerned with the "constant" error. Examination of the means involved indicates an increasing localization accuracy as a function of increasing levels of intelligence.

2. Localization accuracy is significantly modified by practice. The facilitative effects of practice were clearly demonstrated, both in terms of the significant "sessions" effect in each of the analyses, as well as the more general practice effect associated with order of task presentation.

3. The differential effects of motivation at differing levels of intelligence were not a strong or consistant effect across the various types of stimuli and different measures of error. While there were some indications of a decrease in perceptual accuracy in localizing peripheral

stimuli as a function of motivation, generally the effect was not consistent or systematically related to level of intelligence. Of particular interest is the fact that where incentive motivation did have differential influence on the different intelligence levels, the Low and High intelligence groups seemed to be affected similarly while the performance level of the middle or average intelligence group was not modified.

4. The differential effects of motivation on the different intelligence levels for stimuli in the different field positions were most clear in the analysis of the constant error score. Generally, it was found that incentive motivation produced a systematic displacement of stimuli toward the periphery of the field. According to the attentional or "centration" hypothesis of Piaget (52), the data indicate that incentive motivation increases "attention" to stimuli in the center of the field. Thus, the center stimuli appear larger and closer, whereas the apparent size and distance of stimuli in the periphery of the field both decrease.

Experiment IV

The Effect of Training on Perceptual Span

Introduction

The failure to achieve clear-cut effects of incentive motivation on perceptual span as measured by errors of spatial localization poses more problems than it answers. The nature of the errors on the Letters under the different experimental conditions indicates that incentive motivation can modify the *apparent* size and/or distance of objects, presumably through a loss of information relevant to these dimensions of the spatial localization of objects. The question as to whether or not a reduction in assimilation of information relevant to form *recognition* occurs also remains to be answered. If the perceptual constriction hypothesis is valid, more recognition errors would be expected under high levels of motivation; i.e., the number of errors should increase as the object's distance from the center of the perceptual field increases. Prior to investigating the effects of motivation on recognition, however, it was necessary to develop a task situation that would yield sensitive measures of both errors of recognition and of spatial localization. Differential training in perceptual span was selected as the independent variable most likely to produce variation in both errors of recognition and localization. The present investigation was designed, therefore, to determine the effect of differential object dispersion training on form recognition and localization accuracy for objects varying in distance from the center of the perceptual field.

Method

Subjects. Six boys and 6 girls within the average range of intelligence ($\overline{X} = 105$; $s = 8$) were selected from the fifth grade of a local elementary school. The children ranged in age from 10 years, 12 months to 12 years, 8 months. Two boys and two girls were randomly assigned to each of the three experimental groups.

Stimulus Material. Stimuli were constructed for both the experimental and training series. The experimental series consisted of four randomly generated geometric forms whereas the training series consisted of 5 animal silhouettes (Appendix E, Figure 1). Visual displays (35 mm slides) were constructed for both the test and training series. Each slide contained a single target form. The position of the target form on the test display was accomplished as follows: a) the area of each slide was divided into three equidistant concentric circles which subtended 5° 11′ (center), 8° 16′ (intermediate), and 12° 21′ (periphery) visual angle when projected;

b) each of these rings was divided into equal parts by 16 equally spaced points in each of the 4 quadrants; c) four orientations were determined for each of the forms (up, down, left, right) based on the direction of the major axis.

A series of 48 test slides was then constructed by integrating: a) a random series of the four forms with the restriction that each appear 12 times, 2) a random series of 16 positions such that each appeared three times, c) a random series of the three circles with the restriction that each appear 16 times, d) a random series of the four quadrants such that each appeared 12 times, and e) a random series of the four orientations with the restriction that each appear 12 times. No target form appeared twice in the same position. Thus in the series of 48 experimental test trials each form appeared four times on each of the center, intermediate and peripheral rings, once in each of the four quadrants, and three times in each of the four orientations (See Appendix E, Table 1).

Three groups of Training slides (60 slides per group) were also constructed. Group I slides were formed by following the same procedure used in constructing the test series with the exception that 5 animal forms were used. Training slides for Group II (center training) were constructed so that each (animal) figure appeared only twice (rather than 4 times) on the intermediate and peripheral rings and 8 times on the center ring. For Group III (peripheral training) each figure appeared twice on the center and intermediate rings and 8 times on the peripheral ring.

Experimental Task. The experimental arrangement was identical to that described in Experiment III with the exception that S was not given the standard stimulus prior to presentation of the comparison stimulus. Rather, following the presentation of each visual display, S was required to select the "correct form corresponding to that stimulus in the display" from a set of 8 alternatives. S was to place the selected form on the response board such that its location corresponded to its position in the visual display.

Recording of Responses. Two dependent variables measures were used: a) recognition accuracy, and b) localization accuracy. The procedure for recording localization error was identical to that used in the previous experiment (p. 39).

Procedure. All Ss were seen for two sessions. In Session 1 S received the Test series of visual displays (48 trials). In Session 2 each of the three groups received the appropriate Training series (60 trials), followed by re-administration of the Test series (48 trials). The two experimental sessions were separated by an intervening period of three to five days.

Each subject was reminded that the task had no connection with school work but that he should try to do "as well as you can." Ss then were administered a familiarization training task of four slides containing human figures. Fifteen practice trials, using visual displays similar to those in the test series, were administered immediately following the familiarization trials. During these trials, a constant exposure duration of .25 second was used, but illumination level was adjusted so Ss would achieve between 40% to 70% correct responses on the practice trials. The illumination level determined during the practice trials was used for all subsequent presentations of test and training stimuli for that subject. S was administered the 48 visual displays in the Test series during Session 1.

In Session 2 S was again seated behind the response board and general instructions and procedures used in the previous session were reviewed. Following the re-familiarization period, S was shown the standard stimuli for the Training series and instructed: "We are going to do the same thing we did the other day, only this time we will use animal pictures." The series of 60 visual displays appropriate for S's training group then was administered. A short rest period intervened between the 48 Test trials which were re-administered following the Training series.

Results

Recognition Accuracy. The mean recognition accuracy score for each Training condition, for each Session and stimulus position is presented in Table 13. Analysis of variance of the data on which these means are based is presented in Table 2, Appendix E. The relatively few number of subjects and the fact that the Position x Session interaction effects are highly significant ($p = < .001$) suggest the joint effect of Training, Position and Practice on accuracy, while of borderline significance ($F = 1.98$; $p = < .15$), probably represents the most meaningful data for interpretative purposes. Figure 22 illustrates these differential effects of training on recognition accuracy

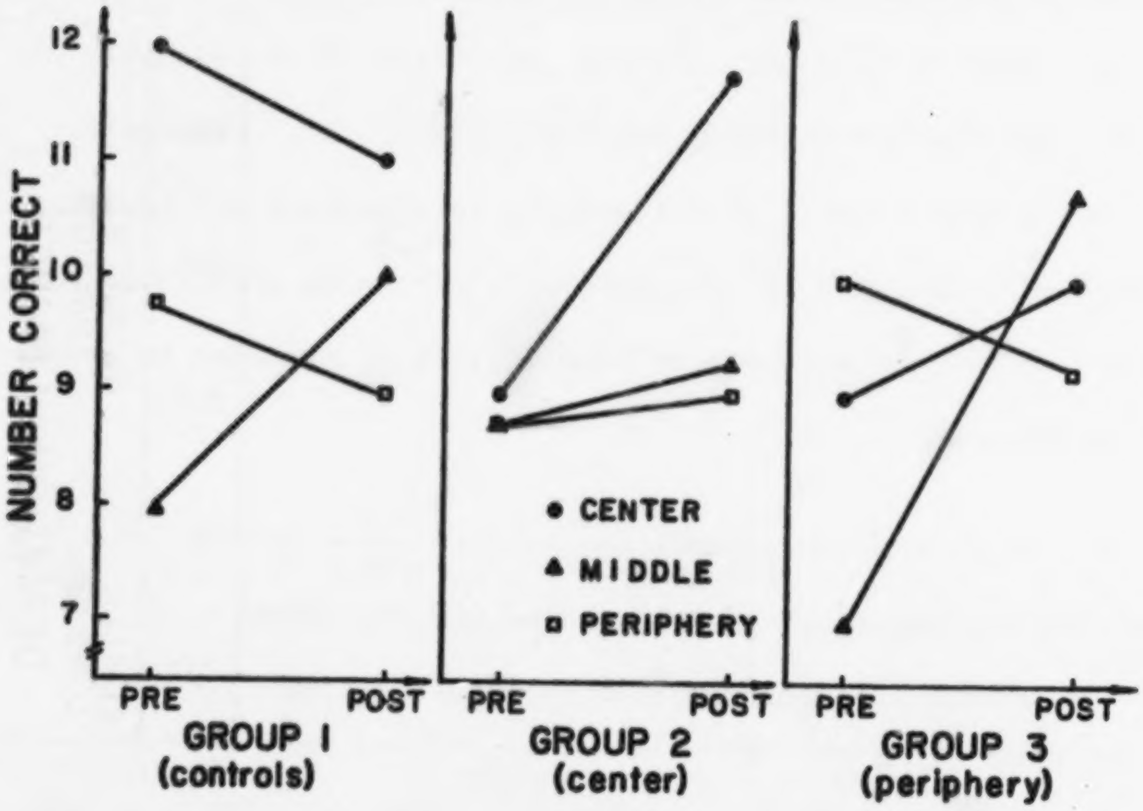
Table 13

Mean Correct Recognition Score in Pre- and Post-Tests as a Function of Training and Stimulus Position

	Stimulus Position					
	Center		Middle		Periphery	
	Pre	Post	Pre	Post	Pre	Post
Group I (Control)	12.00	11.00	9.75	9.00	8.00	10.00
Group II (Center)	9.00	11.75	8.75	9.00	8.75	9.25
Group III (Periphery)	9.00	10.50	10.00	9.25	7.00	10.75

Figure 22

Mean Correct Recognition Responses on Pre- and Post-Tests as a Function of Training and Stimulus Position



for each stimulus position and session. Ss trained on center stimuli (Group II) correctly identified more center stimuli in Session 2, but manifested no improvement in accuracy for the intermediate and peripheral stimuli. Similarly, prior training on peripheral stimuli (Group III) resulted in considerable improvement for recognition of peripheral stimuli, only slight improvement for center stimuli, and a slight decrement for intermediate stimuli. The control group (Group I) which received training on the stimuli with equal probability of location on the three rings manifested slight improvement in accuracy of recognition but only on the peripheral stimuli.

The results of this experiment, while based on only a few subjects, are quite encouraging both in terms of the possibility of increasing the extensity of visual perceptual (attention) span, and for the development of procedures under which recognition accuracy is sensitive to motivational influence.

Localization Accuracy. The results of the effect of training on accuracy on spatial localization are presented in Table 14. Analysis of variance of both the angular and linear localization errors is presented in Appendix E, Table 3. The only significant effect in the analysis of angular scores was that of stimulus position ($p = < .01$). Mean error scores associated with stimuli at the center, intermediate and peripheral locations were 41°, 26°, and 25° respectively. Training conditions had no differential effect on accuracy of localization as measured by errors in angular deviation.

Table 14

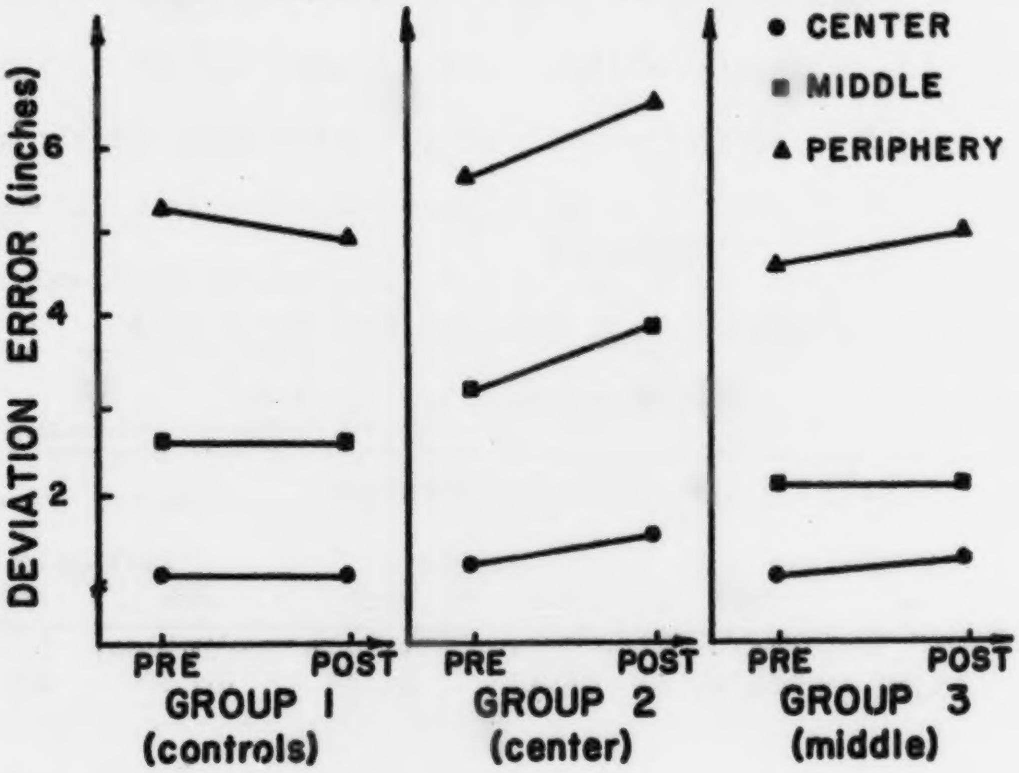
Mean Angular and Linear Error on Pre- and Post-Tests as a Function of Training and Stimulus Position

	Center		Middle		Periphery	
	Pre	Post	Pre	Post	Pre	Post
			A. Angular Error (degrees)			
Group I (Control)	31.43°	51.00°	28.88°	30.37°	27.91°	27.55°
Group II (Center)	34.59°	38.10°	20.10°	26.64°	39.27°	14.97°
Group III (Periphery)	43.12°	47.52°	22.11°	26.66°	14.10°	25.70°
			B. Linear Error (inches)			
Group I (Control)	1.15"	1.15"	2.68"	2.68"	5.25"	4.33"
Group II (Center)	1.22"	1.57"	3.14"	3.88"	5.86"	6.53"
Group III (Periphery)	1.04"	1.31"	2.25"	2.25"	4.69"	5.14"

Analysis of the linear error scores (cf. Table 14 and Appendix E, Table 3) yielded a highly significant main effect due to Position (p = < .001) and a significant interaction between Training group, Position and Session (p = < .05). Localization accuracy, as measured by linear deviation from actual placement, was greatest for the center stimuli (error = 1.24 in.) and increased as a function of distance of the stimuli from the center of the field (peripheral error = 5.30 in.). Figure 23 illustrates the differential effects of training on linear error scores for the three stimulus positions.

Figure 23

Mean Linear Error on Pre- and Post-Tests as a Function of Training and Stimulus Position



Individuals in Group II (center trained) and Group III (peripheral trained) tended to have larger error scores for all stimulus positions on the post-test. In fact, it should be noted that the largest decrement in error occurs for those stimuli located at the "trained" position. Thus the training increased recognition accuracy, but decreased localization accuracy. Before attempting to interpret this apparent paradox, let us determine whether the increased linear error is systematic (i.e., a constant error effect) or error randomly distributed around the objective position of the object in the field.

The mean "constant" error of each training group, for each Session and stimulus location, is presented in Table 15. Analysis of variance of the constant errors in linear deviation (Appendix E, Table 4) revealed no highly statistically significant differences as a function of training or session. A slight trend is noted in the position effect ($p = < .20$); but certainly not interpretable on the basis of so few subjects. However, inspection of Table 15 indicates that Group I showed no change in constant error scores whereas Group II (center trained) displaced center stimuli toward the center, and peripheral stimuli toward a more distant peripheral location. Group III (peripheral trained), on the other hand, displaced

Table 15

Mean Linear Constant Error on Pre- and Post-Tests as a Function of Training and Stimulus Position[1]

	Stimulus Position					
	Center		Middle		Periphery	
	Pre	Post	Pre	Post	Pre	Post
Group I (Control)	55.68	56.84	36.43	37.84	30.55	34.27
Group II (Center)	64.39	40.74	51.18	58.36	42.92	60.44
Group III (Peripheral)	71.05	60.89	55.00	54.97	53.77	48.49

[1] A constant of 50 was added to each raw score.

center stimuli toward the center (to a lesser extent than Group II) and also displaced peripheral stimuli toward the center of the field. These data are suggestive at best, but should they prove replicable with a larger sample, Piaget's concept of "centration" would be considerably strengthened. That is, if improvement in recognition accuracy indicates "perceptual centering," then it would be expected that objects that are the "focus of attention" would appear larger, closer, etc. The increase in total linear error, as well as the trends noted above in the constant error scores, then, would be the predicted results.

Conclusions

The experiment to determine the effects of training in perceptual span on form recognition and localization accuracy yielded results that warrant the following tentative conclusions:

1. Training may significantly modify recognition accuracy for stimuli located varying distances from the center (fixation point) of the visual field.

2. Training on varying extensity of object dispersion in the perceptual field does not significantly influence errors of angular deviation in object localization.

3. Training in varying extensity of object dispersion does significantly influence localization accuracy as measured by linear error score. Further, recognition accuracy is facilitated most for those stimuli located at these trained conditions.

4. Training conditions where stimuli occur most frequently in the periphery of the visual field tended to produce the largest linear localization errors for stimuli in that position.

5. There was slight evidence that training also influences the direction of the linear deviation, i.e., the nature of the constant errors. Individuals trained on objects in the center of the visual field tended, in the test task, to displace centrally located stimuli toward the center, and peripheral stimuli farther away from their objective peripheral localization. Contrary-wise, peripherally trained individuals displaced center stimuli slightly toward the center but, most significantly, also displaced the peripheral stimuli toward the center of the field.

6. Thus, training conditions increased recognition accuracy but decreased localization accuracy as measured by both total and constant linear deviations from the objective position of the stimulus.

7. These data appear to lend strong support to Piaget's concept of perceptual "centration" and the role of attention on perceptual processes. These findings are, therefore, of both theoretical and practical importance; but since the data are based on relatively few subjects, further systematic studies need to be completed.

CHAPTER 4

EFFECT OF INCENTIVE MOTIVATION ON UTILIZATION OF INCIDENTAL CUES IN CONCEPT TRANSFER

Introduction

Bruner et al. (13) and others (16,23,25,39) have reviewed the extensive literature relevant to the effects of overlearning and drive arousal on the reduction in cue utilization in both latent and incidental learning tasks, i.e., "breadth of learning." The hypothesis that increases in motivational level decreases "breadth" of cue utilization in learning appears to have substantial empirical support. Most of the investigations, however, have been concerned with the effect of motivation on incidental learning in relatively simple associative (i.e., S-R) learning situations. The present investigations were concerned with the effects of incentive motivation on incidental cue learning on the more complex process of concept formation (classification or S-S association) and concept transfer.

The formation of the concept involves the development of the awareness of characteristics common to certain objects, attributes or ideas so that such objects, etc., having elements in common may be grouped into separate cognitive categories or classes. Vinache (89) defines concept formation as, "the processes of perception and learning by means of which the individual develops an organized and coherent relationship (to the object) of the outside world. The consequence of these processes is the establishment of concepts, the cognitive structures which link the individual's present perceptions and learning to his previous experience" (p. 36). Most theorists assume that concept formation ranges from a concrete-perceptual through an abstract-conceptual level of classification processes. The formation of concrete concepts involves organizations of experience in which grouping of perceptual elements of the stimulating situation is sufficient for adequate categorization. The formation of abstract concepts, however, involves some form of classification of experience for which sensory experience is insufficient, in itself, as a basis for accurate categorization. Such concepts as size, color, shape or "oddity" are examples of concrete concepts, while such concepts as "causality" and "justice" are examples of abstract concepts. The experiments presented in this section are concerned with tasks which require formation of concepts based upon relationships among and between attributes of objects; i.e., the tasks require cognitive operations more characteristic of concrete perceptual concept formation.

Concept formation requires the differentiation of the attributes of a complex stimulating situation which remain invariant over time and space. In the case of concrete-perceptual concepts, these invariants are composed of stimulus contingencies which may be inherent in the objects (e.g., triangularity) or within the relations among several objects or shapes (e.g., middle-sized, oddity). Differentiation of the invariant attributes which form a particular class or category may require more or less training depending upon the class complexity; i.e., number of informational attributes or elements necessary for classification. In addition, the major hypothesis of this investigation--that increase in motivation reduces environmental information input--suggests that incentive motivation would interfere with the acquisition of complex classification schemas or concepts. Recent studies (79,96) in our laboratory that indicate "breadth of concepts" (i.e., acceptance bands for utilization of classification schemas) decrease with an increase in motivational level which lends support to such an hypothesis.

The present investigations, then, were concerned with the effects of incentive motivation on incidental cue learning in concept formation and transfer tasks. Ss are required to learn a classification rule based on a particular criterial attribute of an object or object set. During training on initial classification, however, a second (incidental) cue is made contingent with the relevant cue for classification on a specified number of trials. In a subsequent task (concept transfer), the incidental cue becomes the relevant cue for classification of a new stimulus set according to the prior learned concept. According to the perceptual-cognitive constriction hypothesis, it would be expected that incentive motivation would decrease the assimilation of the incidental criterial cue, and thus result in relatively less concept transfer.

Experiment V

Effects of Incentive Motivation: Utilization of Visual Information in Concept Transfer

Introduction

The incidental learning experiment was designed to determine the effects of incentive motivation on the transfer of the "oddity" concept on a task requiring processing of "visual" information. The design of the experiment also permitted the assessment of the differential effects of incentive motivation on concept transfer of children who varied in intelligence level.

Method

Subjects. Seventy-seven Ss assigned to the learning group (Chapter 2, p. 8) were able to complete all phases of this experiment. Table 16 presents the number of subjects in each of the experimental sub-groups.

Table 16

Number of Subjects on Concept Transfer (Visual Cue) Under Each of the Experimental Conditions

	Intellectual Level (N = 77)					
	Low		Medium		High	
	Order I	Order II	Order I	Order II	Order I	Order II
Task	8	5	8	7	6	5
Incentive	5	8	7	6	8	4

Order I = FC-NS and Order II = NS-FC.

Stimulus Material. The stimulus materials consisted of two sets of 44 cards each. Each card contained three rows of geometric forms which varied in the dimensions of size (small, medium, large); shape (triangle, squares, pentagons); color (red, blue, yellow); and number of forms in the row (1, 2, 3). In Set I (form - color; FC), number and size constituted irrelevant attributes and varied randomly, while form was the relevant cue, and color the incidental cue for "oddity" during training. For Set II (number - size; NS), form and color were irrelevant cues, whereas number was the relevant, and size the incidental cue during training.

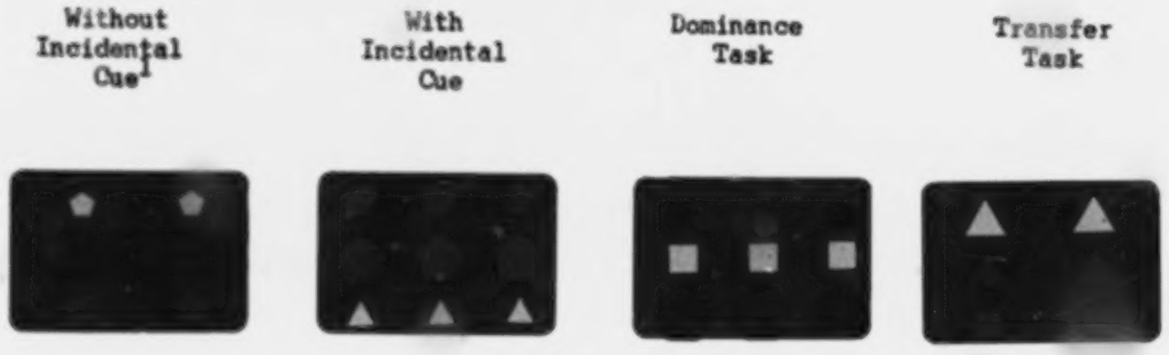
Experimental Task. Each set was so constructed that 20 Training cards, 6 Dominance test cards, and 18 Transfer cards were provided. The incidental cue (e.g., color) was paired with the relevant cue (e.g., form) and thus was contingent with the correct classification response (oddity) on 10 of the 20 Training trials. The Dominance test consisted of 6 cards on which the criterial cue (e.g., form) and the prior incidental cue (e.g., color) were both relevant but for different classification responses on each card; e.g., form "odd" in first row, color "odd" in third row of the stimulus card. The Transfer task consisted of 18 cards on which the previously incidental cue was relevant for classification of oddity but all other attributes varied randomly. Figure 24 presents sample stimuli for each of the stimulus sets and task conditions. Appendix F, Table 1, gives the composition of each task trial for both sets.

Figure 24

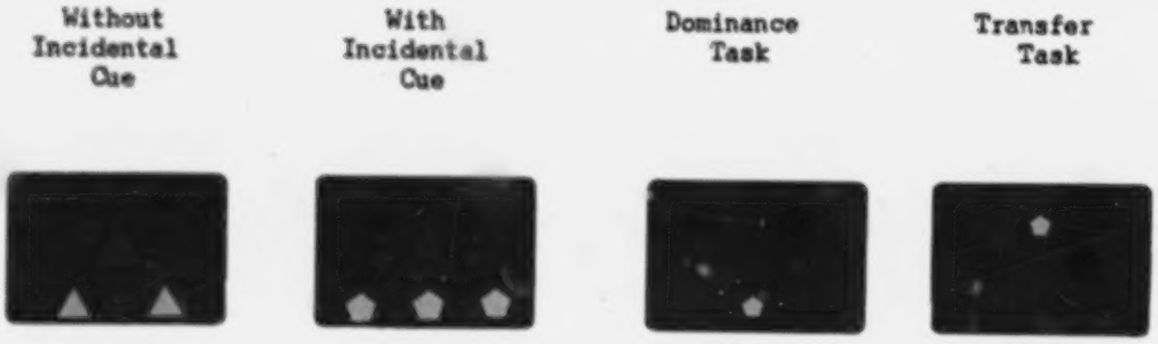
Sample Stimuli for Both Sets for

Concept Transfer (VM) Task

Order I
(FC-NS)



Order II
(NS-FC)



Motivational Conditions. In Session 1 all Ss performed under Task instructional sets, while in Session 2, one-half of the Ss in each intelligence group performed under Task, and the remaining Ss in each group under Incentive instructions (See Chapter 2, p. 10, for detailed instructions). One-half of each group received Set FC in Session 1 and NS in Session 2 (Order 1) while the order was reversed for the remaining subjects (NS, FC).

Procedure. S was brought into the experimental room and the task explained to him. Following the familiarization period and a reminder the task was not related to school work, S was instructed as follows:

> "Here is a pack of cards. I'm going to show you a card for just a short time. Look carefully at the card and tell me which row of figures on the card is different from the others. There will always be some figures that are different and they either will be at the top, middle or bottom. Now look closely and tell me which row is the different one."

The Training trials (N = 20), Dominance Test (6), and the Transfer trials (36) were then administered to each subject. E recorded S's row choice (top, middle, bottom) on each trial for each of the series.

Session 2 was administered 2 to 3 days after Session 1 under motivational and task conditions appropriate to the Ss assigned group.

Results

The criterion of concept transfer was five consecutive correct classifications on the Transfer task. Table 17 presents the mean trials to criterion under each experimental condition and the analysis of variance based on these data is presented in Appendix F, Table 2. Order of presentation of Set 1 and 2 was a significant main effect in transfer ($p = < .05$). Intelligence and Session also were significant main effects at the .10 level of significance. However, with the exception of a slight trend of differential effects of order on the different intelligence levels (Figure 25), none of the interactions were statistically reliable.

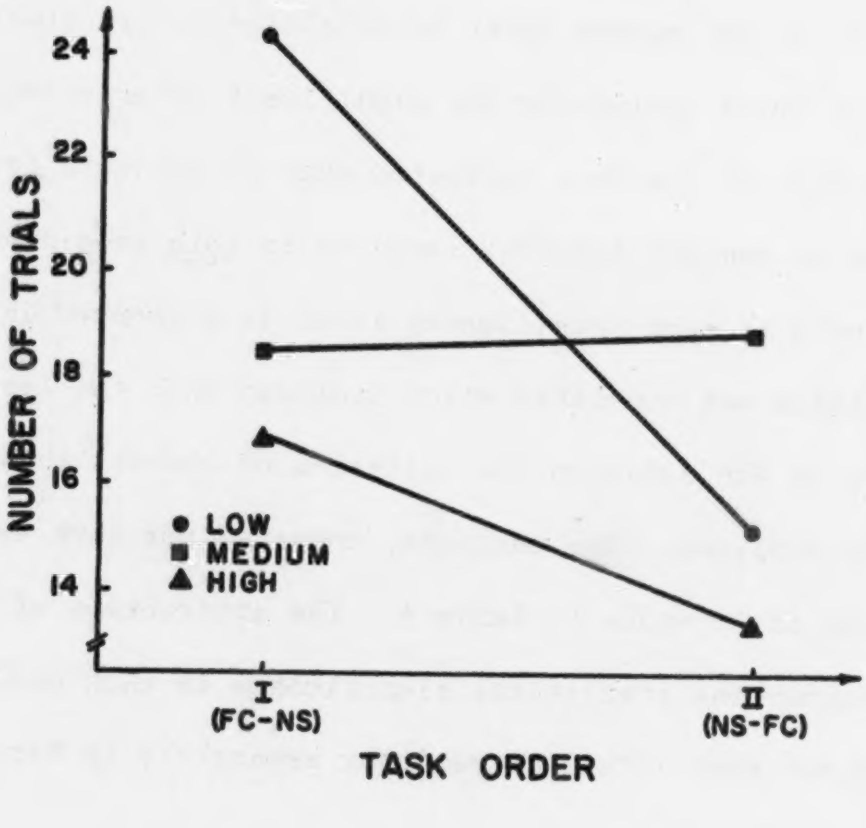
Table 17

Mean Trials to Criterion on Concept Transfer Task as a Function of Intelligence, Motivation, and Practice for Each Order of Presentation

	Task Orientation (T-T)		Incentive Orientation (T-I)	
	Session 1	Session 2	Session 1	Session 2
		Order I (FC-NS)		
Low	24.00	27.50	21.60	25.80
Medium	24.88	19.75	15.14	14.71
High	16.50	16.50	20.50	12.88
		Order II (NS-FC)		
Low	15.60	12.60	16.38	5.88
Medium	22.86	25.00	19.33	8.83
High	20.00	8.80	16.00	7.75

Figure 25

Mean Trials to Criterion on Concept Transfer Task as a Function of Intelligence and Order of Cue Training



The fact that the FC-NS order proved more difficult for all subjects, particularly for the Low intelligence group, suggests that *form* is a strongly pre-potent criterial cue for classification on this particular task. Thus, the children not only failed to assimilate the incidental cue (color) but also the "learning set" (Sessions) gain appeared to be less under this order of presentation.

The significant order effect mentioned above, plus inspection of the data, suggested the influence of the incentive motivation on the transfer of the incidental cue may have been obscured by the potency of the form cue. Analysis of the data for each order separately (Appendix F, Table 3) confirmed this hypothesis. Intelligence was the only significant effect ($p = < .10$) under FC-NS (Order I). However, under Order II (NS-FC) the main effect of intelligence dropped out, but the motivation x session x intelligence interaction approached a satisfactory level of statistical significance ($p = < .12$). Figure 26 illustrates the nature of the differential effect of motivation on incidental cue transfer at the varying levels of intelligence for the Order II condition. The facilitating effects of incentive motivation at the medium level of intelligence are clearly indicated as the primary factor producing the significant interaction effect.

Further inspection of the data indicated that 27 subjects failed to reach the criterion of concept transfer learning in *both* sessions. The number of non-learners at each intelligence level is presented in Table 18. An analysis of variance was completed which included only the learners ($N = 50$); i.e., the *Ss* who achieved the criterion of concept transfer in at least one of the sessions. The analysis, computed for each order separately, is presented in Appendix F, Table 4. The interaction of motivation x session was of borderline statistical significance in each case ($p = < .05$) and is illustrated for each intelligence group separately in Figures 27 and 28.

Figure 26

Mean Trials to Criterion on Concept Transfer Task as a Function of Intelligence, Motivation, and Practice

(Order II)

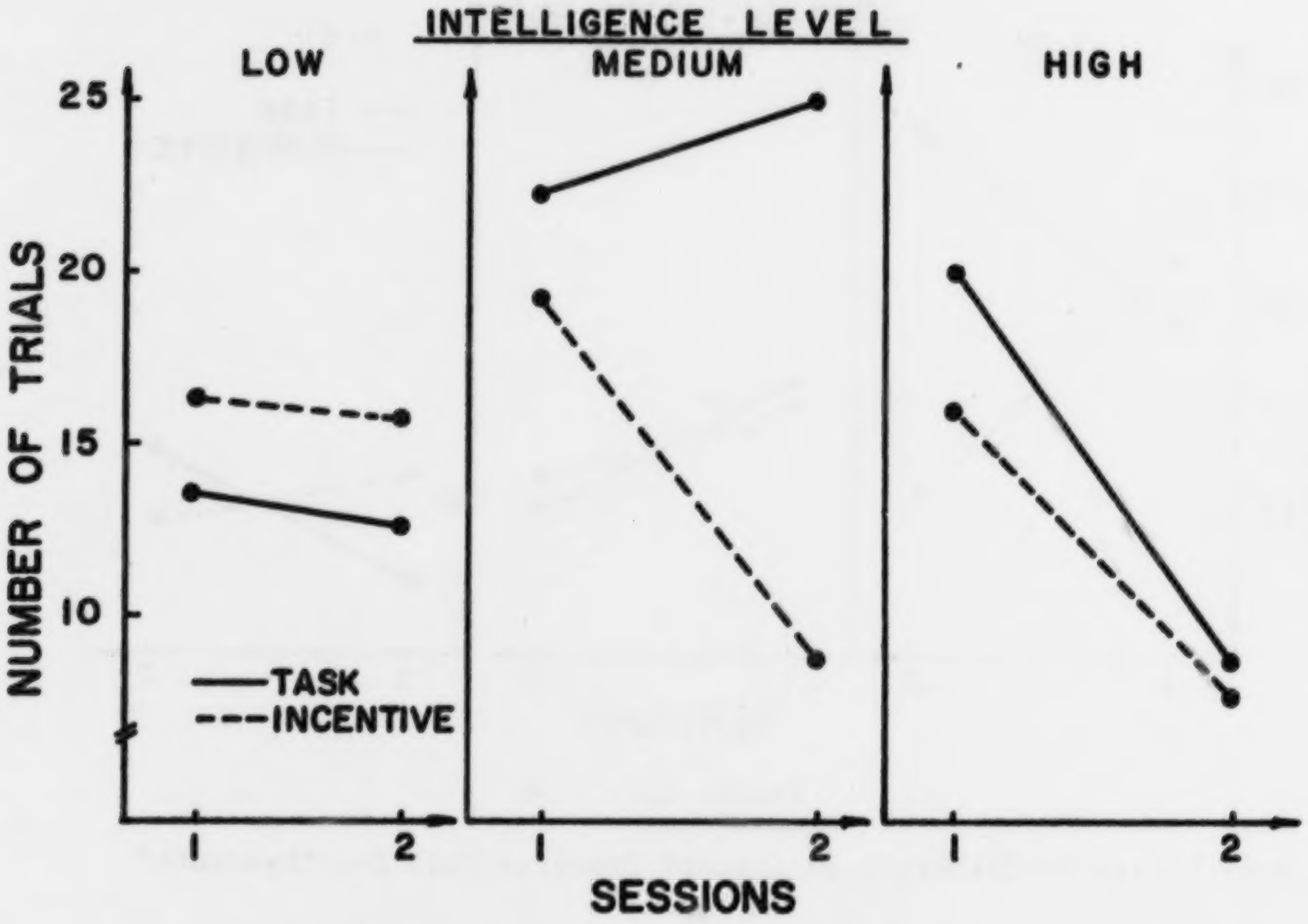


Table 18

Number of Non-Learners on Concept Transfer Task (Visual Cue) in Each Intelligence Group

	Intelligence Level		
	Low	Medium	High
Task	5	9	3
Incentive	6	1	3

Figure 27

Mean Trials to Criterion on Concept Transfer Task for "Learners" as a Function of Intelligence, Motivation, and Practice

(Order I)

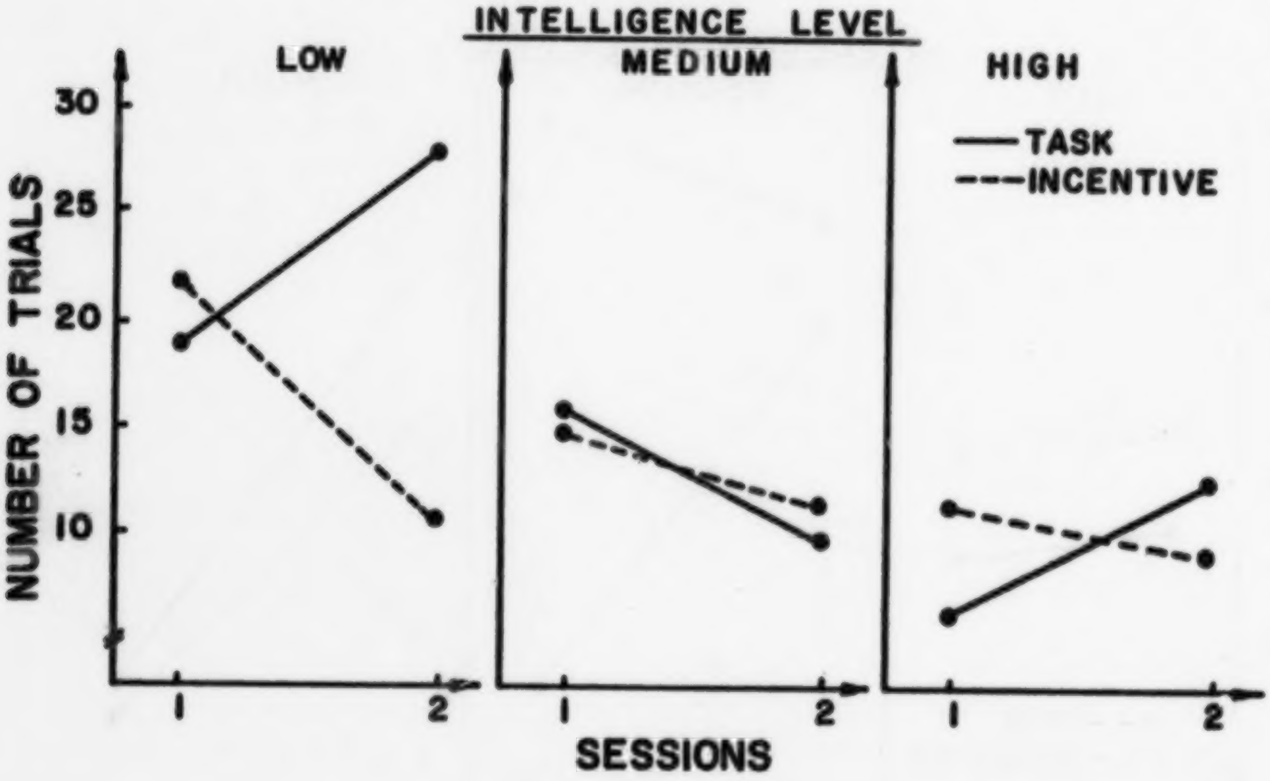
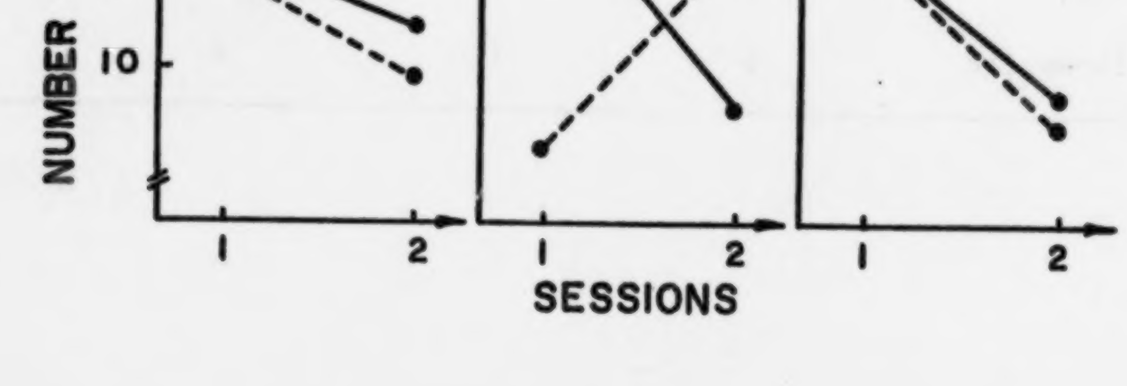


Figure 28

Mean Trials to Criterion on Concept Transfer Task for "Learners" as a Function of Intelligence, Motivation, and Practice

(Order II)



Conclusions

The results of the investigation of the effect of incentive motivation on utilization of visual cues in concept transfer suggest the conclusions:

1. Intelligence level is a significant factor in incidental learning and utilization of "visual information" in the concept acquisition and transfer process.

2. The significant practice effects indicate the facilitative role of prior concept transfer experience on subsequent classification Transfer tasks. These effects appear similar to the "learning set" phenomenon described by Harlow (15,32).

3. The type of cues that are criterial for initial learning of the concept is an important determiner of the amount of incidental cue learning and concept transfer. Specifically, utilization of form as a criterial cue during training had a detrimental effect on performance on the transfer of the incidental cue to a new classification task.

4. Incentive motivation facilitates incidental cue transfer on a concept utilization task, particularly for individuals of below average intelligence.

Experiment VI

Effects of Incentive Motivation: Utilization of Tactile-Kinesthetic Information in Concept Transfer[1]

Introduction

Developmental and learning theorists have assumed that kinesthetic feedback stimuli ("movement produced cues") play a major role in the learning of spatial orientation (26,40,52), early language acquisition (52,60), and complex symbolic behavior (9,64). Psychologists' concentration on the visual processing mechanism, however, has led to a paucity of knowledge of the actual contribution of tactile-kinesthetic processing mechanisms to learning. The work of Piaget (52), Werner (93), for example, indicates the great theoretical and practical significance of such information. Reisen (cf. Hebb, 34), for example, demonstrated that children who were blind in infancy but recovered their sight later in life had to go through a long process of visual learning in order to "recognize" triangularity on the basis of "visual information" even though the concept was well established on the basis of tactile-kinesthetic cues. The effect of motivational factors on learning based on kinesthetic cues, and on "sensory-interaction" processes generally, during early stages of development constitutes a fundamental, but sadly neglected, area of research.

The present investigation is admittedly a preliminary attempt to study one aspect of the broader problem. However, it is expected that such a study will at least provide information relevant to the development of paradigms for studying the influence of motivation on the efficiency of tactile-kinesthetic cue utilization in concept transfer.

---

[1] Several preliminary studies were required before task conditions appropriate to our purpose were developed. Thus, the number of subjects on which this reported study is based was reduced from the original sample of children (p. 7).

The format of the task was essentially the same as that reported in the previous concept transfer experiment and that used by Bruner, Papaneck, & Matter (13) in their study of "breadth of learning." Children were required to learn a spatial pattern rather than to classify objects on the basis of "oddity." Relevant "turning cues" were systematically paired with "incidental" cues for a number of the training trials. A Transfer pattern was then introduced to determine the extent of utilization of the prior incidental cue in transversing the pattern maze. It was predicted that incentive motivation would decrease utilization of the incidental cue on the pattern transfer task.

Method

Subjects. The full description of the subject pool from which Ss were selected may be found in Chapter 2 (p. 7) of this report. The distribution of Ss under each experimental condition is presented in Table 19.

Table 19

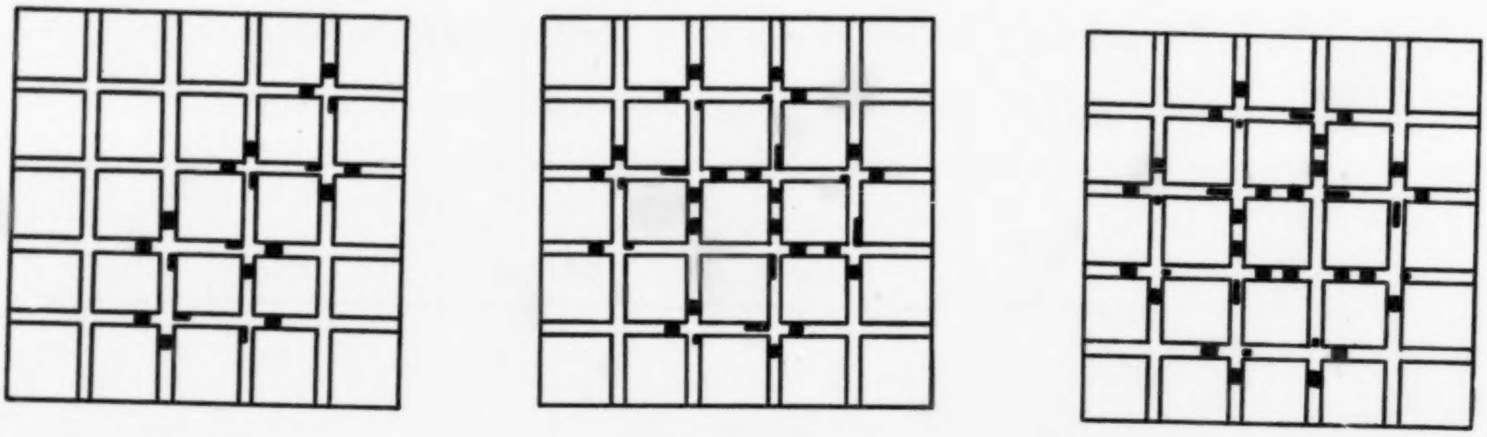
Number of Subjects Under Each Experimental Condition in Pattern Transfer Task: Tactile-Kinesthetic Cue

	Intelligence Levels		
	Low	Medium	High
Task	4	7	10
Incentive	4	10	9

Task Requirement. Ss were presented with three successive maze (finger) patterns to learn. Maze A (pretraining) was used to train Ss that a particular cue dimension (rough-smooth, or short-long) would indicate which direction he was to turn at each choice point. On the Incidental training maze (B) the relevant cue (e.g., rough) was paired with the incidental cue (e.g., length) indicating direction of choice point turns. The pattern Transfer task (Maze C) was then presented in which only the previously incidental cue (e.g., length) was relevant and the prior criterial cue was now irrelevant. The pre-training maze (Maze A) consisted of 7 choice points while the Training and Transfer mazes (B and C respectively) consisted of 12 choice points in the pattern. Figure 29 presents an illustration of each the pre-training (Maze A), incidental-cue training (Maze B) and the pattern transfer task (Maze C).

Figure 29

Schematic Representation of Pre-training, Incidental Cue Training and Pattern Transfer Mazes



Pre-Training

Incidental Cue Training

Pattern Transfer

During incidental-cue training (Maze B) rough-smooth was the relevant dimension (e.g., rough = turn this way) and length (e.g., short) was the incidental cue of all choice points. Each S was trained to complete 2 consecutive trials correct, or to a maximum of 14 trials through the pattern. On the transfer maze, the previously relevant cue (e.g., rough-smooth) was made irrelevant by placing it in the middle of the alley way and the incidental cue (length) became relevant for directional choices. A balanced design was used so that all cue-directions and relevant-incidental cue combinations were represented across the groups of Ss.

All choice point errors were recorded on all maze trials. The dependent variable measure was the number of errors on each of the pattern trials during transfer.

Motivational Conditions. In Session 1 all Ss performed under task oriented instructions whereas in Session 2 one-half of the Ss performed under task, and half under incentive motivational conditions, (Chapter 2, p. 10).

Procedure. Following the familiarization period, S was blindfolded and given the instructions for Maze A:

> "I'm going to put your finger at the beginning of this road-way. If you follow the path you will get to a point where you will have to turn right or left. The idea is to go through the maze without making mistakes trying to figure out which way to turn. Here is a hint. If you go slowly and pay attention to the place in the path where it is rough or smooth it will tell you which way to turn. (S was told whether he was correct or incorrect after each choice.) That was a good try. Did you notice anything special about the pathways. What? Did you feel anything rough? Here is another hint. When you go along the pathway you come to a place that is rough or smooth on one side. If you turn to the same side as the roughness, you will be correct every time. Go slowly and use the hint as you go through the roadway."

After S had gone through the pre-training maze twice without error the incidental cue training (Maze B) was then introduced and S instructed:

> "You can go through this new maze best if you use the same hints as you did before."

The transfer maze was introduced immediately following the incidental cue training. The instructions were as follows:

> "Now let's try another one. This one is a little different but you try to figure out how to get through it all by yourself."

The criterion of transfer was two consecutive correct trials through the pattern or a maximum of 6 such trials.

Results

Table 20 presents the mean transfer scores for each intelligence and motivational group for each session. Analysis of variance of these data (Appendix G, Table 1) indicated that neither motivation, intelligence nor any of the interactions were significant sources of systematic variation. However, there was a statistically significant improvement in pattern learning as a function of prior experience (Session effect, $p = < .02$); the mean number of errors in Session 1 was 4.86 as contrasted to 4.13 in Session 2. The only other significant source of variance was the trials effect ($p = < .01$), but there was no differential effect of practice [illegible]

Table 20

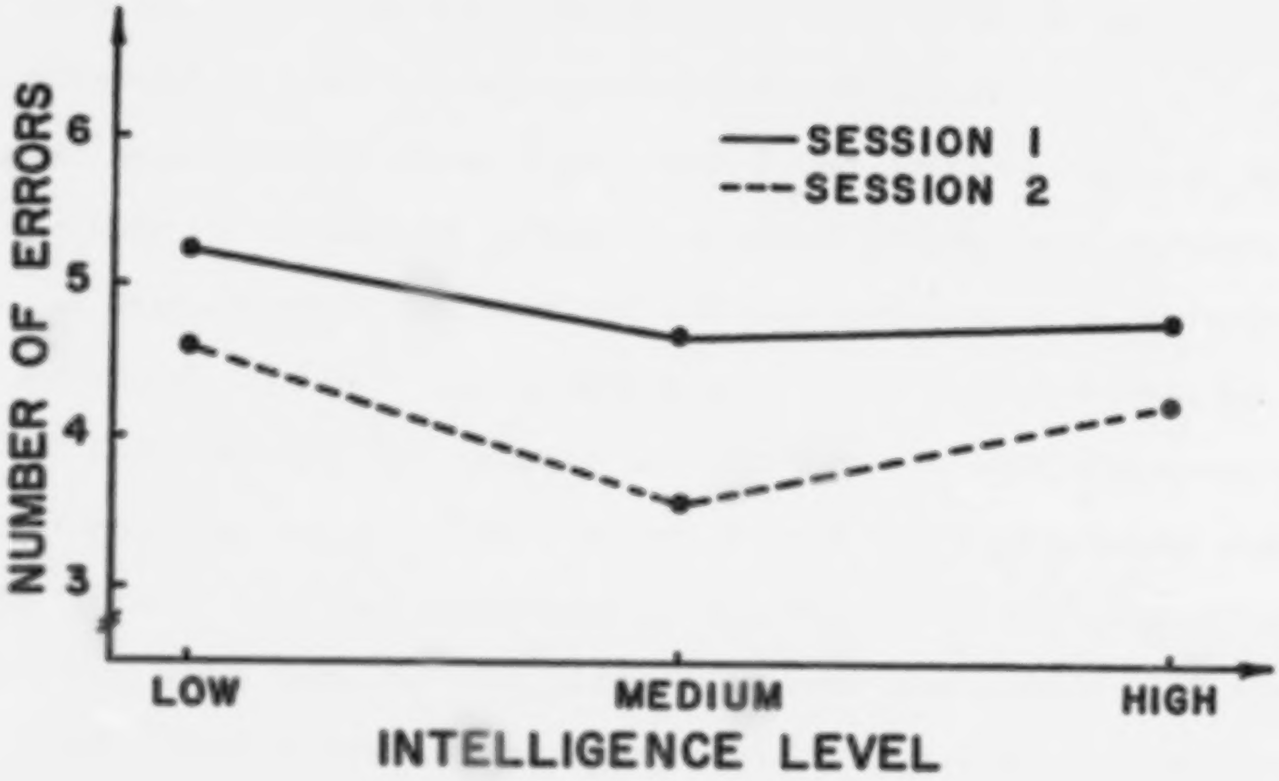
Mean Errors on Pattern Transfer Task as a Function of Intelligence, Motivation, and Practice

	Task Orientation (T-T)		Incentive Orientation (T-I)	
	Session 1	Session 2	Session 1	Session 2
Low	5.12	4.71	5.12	4.50
Medium	4.74	4.05	4.62	3.08
High	4.62	4.18	4.96	4.24

for the different motivation or intelligence groups ($p = < .15$). Figure 30 presents a graphic illustration of the similarity in the practice effects for the three intelligence groups.

Figure 30

Mean Error on Pattern Transfer Task as a Function of Intelligence and Practice



Conclusions

1. Transfer of criterial cues which have been "incidental" during pattern learning was neither facilitated nor impaired by either incentive motivation or intelligence level.

2. Ss in each of the intelligence levels and motivation groups profited equally from both the general "learning set" (sessions) and task specific types (trials) of practice.

Experiment VII

Effects of Incentive Motivation: Utilization of Tactile-Kinesthetic Information in Concept Transfer as Related to Level of Spatial Concepts

Introduction

Neither intelligence nor incentive motivation proved to be a determinant of transfer on the pattern-concept tasks. In fact, it was only after several preliminary studies that any positive transfer could be demonstrated. Observation of Ss' behavior, particularly their verbalizations during the task, suggested that general confusion in spatial coordinates and of directional orientation might be responsible for the inability of the children to learn the pattern, and to profit from incidental-cue training. Inspection of the mazes (See page 76) indicates, for example, that the individual was sometimes progressing toward himself when a "right" turn was necessary to follow the path. In order to develop an appropriate cognitive "picture" of the maze, the children must have sufficiently well developed space concepts and to be able to "decenter" and reverse spatial perspective (52). The purpose of this study was to explore the relationship between one aspect of spatial concepts (horizontal-vertical coordinate system) and concept transfer utilizing tactile-kinesthetic cues.

Method

Subjects. Forty fifth grade boys and girls drawn from a local elementary school (Chapter 2, page 7) were utilized for this study. An equal number of boys and girls were randomly assigned to Task and Incentive motivational groups.

Task Requirement. The mazes (B and C) designed for incidental cue learning and concept transfer from the previous study were used. However, the number of choice points in each maze was reduced to nine. Each S was administered the incidental cue training (Maze B) to a criterion of 4 of 6 trials correct or to a 25 minute time limit. The transfer trials (Maze C) were administered to all Ss.

Orientation Task. Prior to the beginning of incidental-cue Training, and immediately following the Transfer task, Ss were administered a test designed to measure the level of development of spatial orientation. The task consisted of a series of eight trials where the S was to turn "right" or "left" as he was moving in different directions. The S was given a small car and instructed as follows:

> "I want to find out how well you can turn right or left when you are moving in different directions. Here is an example. Pretend you are driving this car and going in this direction; which way would you go if you wanted to turn right. Now, suppose you were moving in this direction and you wanted to turn right, which way would you turn." (etc.)

Each S was administered 8 pre- and 8 post-test trials: Two trials were given in which the car was moving in each of the four cardinal directions. On one of these two trials, S was to turn right, while on the other trial a left turn was required. Identical procedures were used in administering the post-test following the pattern Transfer task.

Procedure. The Pre-test Orientation task, the Maze tasks and the Post-test Orientation task were administered in that order. The appropriate motivation instructions (Task or Incentive) were introduced after the Pre-test. The design of this study was different than the previous one in that the Incentive motivation was introduced in Session 1 (for one-half of the Ss) since time limitation did not permit the use of the two-session control feature.

Results

Transfer. The mean number of correct responses on the pattern transfer task as a function of intelligence motivation and practice is presented in Table 21. The summary of the analysis of variance of these data is presented in Table 2, Appendix G.

Table 21

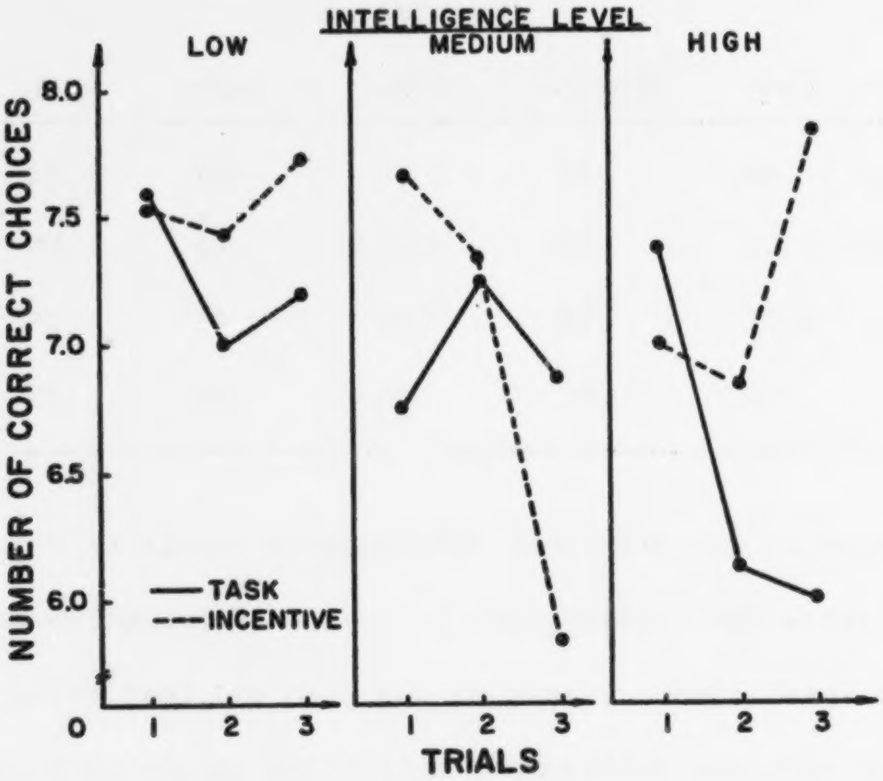
Mean Correct Response on Pattern Transfer Task as a Function of Intelligence, Motivation, and Practice

	Task Orientation (T-T)			Incentive Orientation (T-I)		
	Trial 1	Trial 2	Trial 3	Trial 1	Trial 2	Trial 3
Low	7.60	7.00	7.20	7.57	7.43	7.71
Medium	6.75	7.25	6.88	7.67	7.33	5.83
High	7.83	6.13	6.00	7.00	6.83	7.83

The main effects of intelligence and motivation were not significant. However, the differential effect of motivation at the different intellectual levels was significant beyond the .05 level. Figure 31 illustrates the nature of these effects. The interaction is primarily a function of the facilitative effect of incentive motivation on maintaining the performance of Low and High Ss throughout the task. The Medium intelligence level group was affected by the incentive only during earlier stages of practice. These results generally confirm the importance of practice on pattern transfer that was apparent in the previous experiment. Further, the positive effects of incentive motivation on pattern transfer for the children of relatively lower intelligence were such as to maintain performance at a relatively high level as compared to the Medium and High intellectual groups.

Figure 31

Mean Correct Choice Responses on Pattern Transfer Task as a Function of Intelligence, Motivation, and Practice



Orientation Measure. Table 22 presents the mean number of correct directional responses on the orientation task as a function of intelligence and direction of movement. Analysis of variance of these data (Appendix G, Table 3) indicates both intelligence (F = 2.69, p = < .05) and orientation (F= 9.69, p = < .001) are statistically significant factors in orientation accuracy. Inspection of the data in Table 22 indicates that there was a positive relationship between level of intelligence and number of correct directional turns, whereas the order of difficulty for the different initial orientations (i.e., initial direction of movement) was: toward, left, right and away from self.

The only other significant source of variation involved the interaction of motivation and pre-post testing (p = .01) and the differential effects

Table 22

Mean Correct Directional Response as a Function of
Intelligence and Orientation

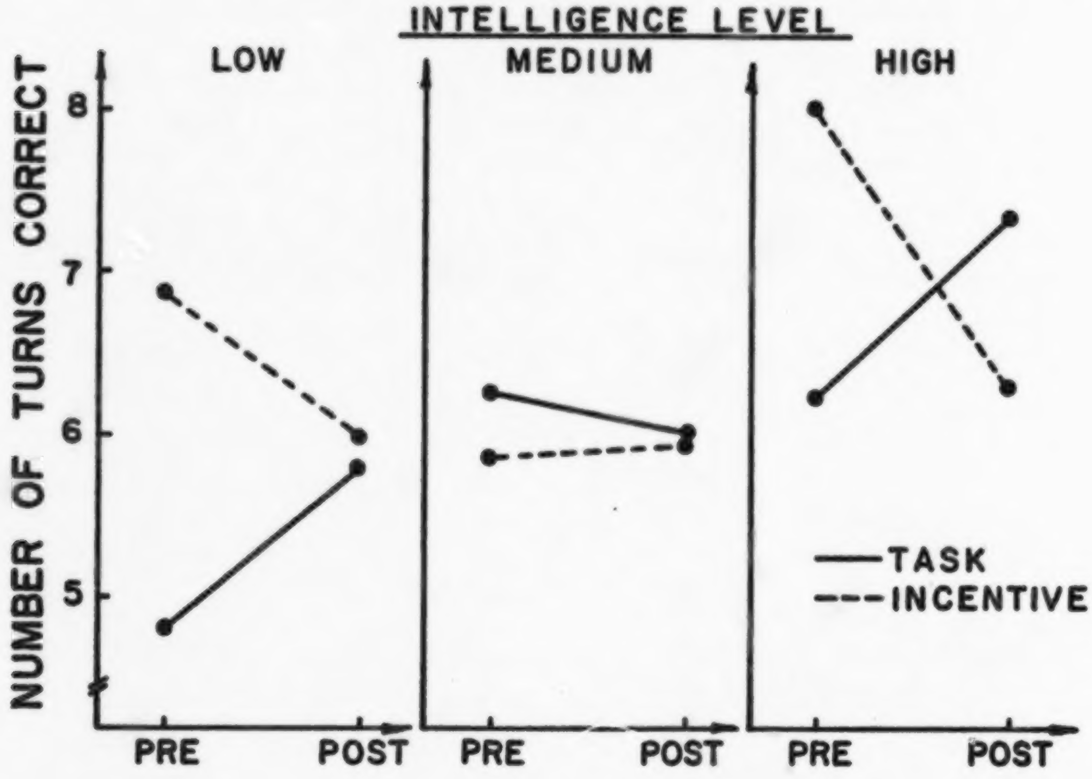
	Orientation				
	Away	Toward	Right	Left	Mean
Low	.96	.53	.83	.62	.74
Medium	.87	.59	.87	.68	.75
High	1.00	.69	.94	.91	.89
Mean	.94	.60	.88	.74	.79

of this interaction at the different intelligence levels ($p = < .05$). Figure 32 illustrates the differential influence of incentive motivation at the different intelligence levels on the pre- and post tests. It should be noted that the task and achievement motivation groups were not equated in the Low and High intelligence groups as might be expected on the basis of the random assignment. Thus, the highly significant motivation x pre-post interaction partially reflects the effects of repeated measurement on this task. However, it would appear from the data presented in Figure 32 that the motivational variable differentially affected performance at the different intelligence levels over and beyond the practice effect. Incentive motivation tended to decrease orientation accuracy whereas *S*s under Task motivation demonstrated significant improvement in orientation accuracy.

Relationship of Spatial Concept Level to Pattern Transfer. A major question of this study was the extent to which performance on the pattern transfer maze task was dependent on level of development of spatial concepts. Pearson-product moment correlations were computed between the pre-test orientation measure and the pattern transfer score for each intelligence

Figure 32

Number of Turns Correct as a Function of Intelligence, Motivation, and Pre-Post Tests



group. The obtained correlations were: Low group = .19, Medium group = .08 and High intelligence group = .03. Obtained correlations for each motivational group and for each transfer trial separately also failed to yield any significant relationship between performance on the orientation and pattern transfer task.

Conclusions

1. Incentive motivation tends to maintain relatively high incidental cue utilization on a pattern transfer for individuals of below average intelligence.

2. Intelligence is positively related to performance on a spatial orientation task.

3. Incentive motivation decreases spatial orientation accuracy equally for Low and High intelligence subjects, but does not affect the performance of children of average intellectual level.

4. There was no demonstrable relationship between performance on the pattern transfer task and level of development of spatial concepts as measured by the orientation task.

CHAPTER 5

DISCUSSIONS AND IMPLICATIONS

The findings of the several experiments reported here have theoretical, methodological, and practical implications for understanding the educational process. Limitations and qualifications attached to these implications may not always be obvious in the context of the discussion Repetitious statements of such limitations, on the other hand, interfere with clear communication and prove burdensome to the reader. The following cautions are presented so we might avoid the above disadvantages and, at the same time, provide an interpretative framework that permits reasonable generalizations based on the obtained results.

The primary concern of this investigation was the effect of incentive motivational conditions on selected aspects of perceptual-cognitive proficiency. Previous investigations (23,74,78) provide sufficient evidence that increased drive or motivational level, defined in terms of psychological and/or physiological stress situations, reduces the efficiency of cue utilization. The influence of motivational conditions more prototypical of social-educational situations on cue utilization in perceptual and concept formation task, however, has received little systematic attention. The selection of incentive motivation as the primary independent variable was intended, therefore, to provide information relevant to this gap in our knowledge of the effect of motivational processes on learning.

The introduction of an independent variable about which little is known in the context of the cue utilization process required that relatively stringent conditions be used for measuring the dependent variables. For that reason, we chose perceptual and cognitive tasks on the basis of the following criteria: 1) they should be relatively simple task situations; 2) data were available on other variables that influenced performance even though it was from other experimental contexts; and 3) the tasks were as analogous as possible to some aspects of educational task situations as the first two criteria would permit.

Psychological theorists differ on the question as to whether the perceptual and cognitive-symbolic activity represents a single or independent continuous processes (eg, 52). We assumed, for our study, that perception and cognition represent at least two "levels of abstraction". Organization of experiences wherein grouping of elements of stimulus situation is sufficient for categorization represents a perceptual process, whereas organization of experiences that do not depend entirely on immediate sensory input reflects a conceptual or symbolic level of activity. The selection of specific experimental tasks, therefore, was guided by the criteria mentioned and the additional desire to determine whether incentive motivation influenced cue utilization efficiency at both the perceptual and cognitive level of functioning. The main studies, form recognition, perceptual span, and concept transfer, then are to be considered as experimental paradigms representing possible approaches to the study of the effect of incentive motivation on perceptual-cognitive proficiency.

Generalizations from the data obtained in this investigation to the educational process are subject, therefore, to greater or lesser limitation inherent in any discrepancy between the experimental tasks and the related educational task, e.g., reading. The advantages and disadvantages of the strategy we selected are subject, of course, to some controversy. A major factor in any such problem is the present state of knowledge regarding the complex mental processes underlying education. It is expected that accumulation of further knowledge of the effects of the specific variables regulating performance will permit more systematic study of complex processes more directly relevant to the educational learning tasks. One example of this is the recent translation of the concept of "form invariance" to the analysis of letters of the alphabet (76). If successful, it will provide a means for studying the effects of incentive motivation on the acquisition of basic perceptual skill necessary for reading. Such an investigation would permit an experimental analysis that is "closer" to the "real" reading acquisition process than the object-form recognition study reported here. The project reported here has served its purpose if it suggests similar methods for studying complex educational processes.

The purpose of this investigation was to determine the effect of incentive motivation on cue utilization of children who vary in intellectual level. The problem emerged from consideration of the substantial experimental evidence (cf. 23) which indicates the relationship between performance proficiency, on a variety of tasks, and level of motivation tends to be curvilinear. Performance proficiency tends to increase to some optimunal level of motivation and then to decline with further increase in drive level or motivation. Cognitive theorists (10,13,16,22,35), particularly Tolman (88), have proposed one plausible explanation for the curvilinear relationship between motivational level and performance. According to Tolman (88), increases in drive or motivation reduce the range and breadth of cues to which an individual responds; i.e., it decreases the assimilation of motivationally irrelevant information from the environment. The effect of motivational increase on efficiency of incidental learning (2,12,53), latent learning (13,23,82) and accuracy of spatial localization (3,5,8,14) lends general support of this contention.

Several theoretical and methodological questions remain unanswered, however. First, recent evidence indicates that the type of operation used to increase motivational level (e.g., physical and psychological stress vs. incentives) does not exert similar influence on cue utilization efficiency. Second, a wide variety of task situations has been utilized, but experimenters have not differentiated between the perceptual and conceptual processes and the possible differential effects of motivation on different levels of cognitive activity. Third, there is to date no satisfactory explanation as to why a "small" increase in motivational level should produce an increase in assimilation of task relevant cues whereas further increases result in a decrement of utilization of task cues. The data clearly indicate such is the case, but the process or mechanism by which a shift in proportion of relevant to irrelevant cues assimilated has not been clarified. Finally, there has been few attempts to select tasks which have relatively high congruence with learning situations common to educational tasks.

The first question this investigation tried to answer was: What effect does incentive motivation have on cue utilization at both the perceptual and cognitive level of functioning? The data afford a clear and impressive answer to this general question. Accuracy of form recognition and concept of transfer was significantly facilitated under the incentive conditions. Although there were some exceptions, the facilitative effects of incentives were present at each of the three intelligence levels. These findings, then, lend support to the hypothesis that incentive motivation increases the utilization of task relevant cues and thus facilitates perceptual and conceptual efficiency. Further, incentives generally facilitate perceptual-cognitive efficiency of "slow learners" as well as that of the child of average and above average intelligence.

These findings are open to several interpretations. The most straightforward suggestion is the task conditions (i.e., complexity and incentive value) were such that the data reflect the facilitative phase of the curvilinear relation between motivation and performance. Such a statement is perfectly satisfactory as a description of the findings, but does not explain the increased assimilation of cues relevant to form discrimination and concept formation.

The interpretation we favor emphasizes that any increase in motivational level narrows the range of motivationally relevant cues to which the individual responds, i.e., "narrows attention" (16). Examination of these data provides several lines of evidence which supports the necessity for postulating such a selective or organizing mechanism underlying increase in the proportion of task relevant cues utilized under incentive motivation conditions.

The investigation of variation in perceptual span under incentive conditions provides the clearest evidence for the narrowed attention hypothesis. Incentive produced an increase in spatial localization accuracy as measured both by linear and angular deviation. Most relevant, however, is the fact that the constant error analysis revealed a tendency toward systematic outward displacement of stimuli in the periphery of the perceptual field. These results would obtain under conditions where simuli in the center of the field appear larger and closer, whereas apparent distance and size of stimuli in the periphery of the field decreased. Conversely, a decrease in apparent size (or distance) of peripherally located stimuli would tend to produce a displacement error toward the periphery. The "narrowing of attention" (16,42) or "centration" (52) hypothesis suggested above would predict such direct perceptual consequences of incentive motivation.

The supplementary experiment, as expected, indicated similar effects could be achieved through training. In that experiment a further prediction was made. Specifically, the training conditions should increase the magnitude of recognition error for stimuli located in the "untrained" positions (i.e., center or periphery) of the field. The decrease in recognition accuracy for stimuli located in the periphery for individuals who were trained with stimuli in the center positions lends further support to the selective attention hypothesis.

The results of the investigation of incentive motivation and form recognition accuracy also were contrary to any simple interpretation in terms of absolute number of cues assimilated. Incentive motivation had a consistent facilitative effect over all three levels of form complexity. If the increases in motivation level produced a constant numerical reduction in number of cues utilized (38) then perceptual efficiency should have changed relatively less with each increase in stimulus complexity; i.e., the number of cues "omitted" should become a smaller and smaller proportion of the total number of available cues. However, if the change in cue utilization accompanying incentive motivation is assumed to involve a shift in assimilative ease associated with particular informational dimensions of the stimulus then the proportion of relevant cues utilized would be expected to remain constant. The obtained data are most congruent with the latter interpretation.

It also had been expected that learning of incidental cues during concept training would be impaired under incentive motivation (cf. 23).

However, the data indicated assimilation of incidental cue contingent with the criterial cues for the concept increased under incentive conditions. The only exception to these data was obtained with the "low" intelligence children under one task condition. The main pattern of these results on both the perception and concept transfer tasks suggests that incentive motivation produces a "narrowing of attention" to task relevant cues. Such a process probably involves a central selective process rather than any simple information reduction. The relationship between incentive motivation and the selective process as it operates in more complex tasks will require further investigation.

A second major question of this investigation was the relationship between perceptual-cognitive proficiency and general intelligence level. The first finding of significance was the consistency with which intellectual level was an important determinant for baseline perceptual accuracy. Previous research on the relationship of perceptual ability to general intelligence (cf. 47) has led to equivocal results. In view of this prior research, as well as the relatively simple nature of the task used in this study, it was expected that intelligence would not have a significant relationship to perceptual accuracy. However, the data clearly indicate that intellectual level is positively related for form recognition and perceptual span as well as performance on the more complex concept transfer task.

Several perceptual theorists (1,34) have recently emphasized that object-shape perception depends upon the simultaneous assimilation of informational dimensions or attributes which define the object. Such criterial dimensions as axial rotation, complexity, symmetry, etc., may be assumed to define a form. The differences in form recognition accuracy attributable to intelligence level, therefore, might arise from the tendency for the "dull" to respond to these aspects of the form that have less "criterial validity" for differentiating it from other forms. A second possibility is that children of lower intelligence do not have the capacity to utilize combination of shape cues necessary for adequate recognition (i.e., low perceptual integration ability). The supplementary experiment, however, did not yield an interaction between level of intelligence and utilization of particular dimensions of form. Further, the opportunity for increased perception time (scanning) improved recognition accuracy of the "low" intelligence children only slightly more than that of children of higher intelligence. These data do not support the selective assimilation hypothesis, and offer only tentative confirmation of the perceptual integration explanation.

The results of the concept transfer study, in addition to those reported above, suggest the relationship between the specific aspects of perceptual functioning (e.g., figure-ground perception, illusions) and "intelligence" warrants more extensive investigation than has heretofore occurred. Children in the "low" intelligence group had particular difficulty in concept transfer where the form and color cues were criterial for classification. The most plausible interpretation of this finding is that the children of lower intelligence are more "concrete" (52). The pre-potency of cues requiring only spatial (rather than temporal) integration tended to interfere with transfer of the incidental criterial cue. However, it would follow from this interpretation that concept learning and transfer might well be facilitated for the slow learner by taking advantage of this dependence on "concrete" representation. One important area of future research should be an examination of the effect of different spatial and temporal integration task requirements on concept learning in children. The study of these factors at an early level of perceptual-cognitive development might be particularly fruitful for revealing the nature of the correspondence, divergence, and interaction of perceptual and symbolic processes.

A third question, and perhaps the primary purpose of the study, concerned the differential influence of incentive motivation on perceptual-cognitive proficiency of children who vary in intelligence level. The data did not reveal any consistent, nor impressive, differential effects of motivation at the differing levels of intelligence. However, the pattern of results, together with certain trends, is suggestive and worthy of comment. First, examination of the effects of incentive motivation on the performance of children in the "low" intelligence group indicated: 1) that form recognition accuracy was facilitated by the incentive condition to the same degree as the performance of children of higher intelligence; 2) incentive motivation facilitated concept transfer relatively less for children in the "low" group and in one task produced a decrement in performance; 3) incentive motivation exerted relatively more of a "narrowing of attention" effect for the "low" intelligence children as determined by the perceptual span task. These data suggest that the differential effects of incentive motivation on the performance of the "low" intelligence children are a function of the degree of "cognitive strain" (18,81) required for task completion. Performance on tasks that require relatively little temporal integration, such as perceptual recognition, was facilitated by the incentive condition. On the other hand, tasks that involve a relatively high level of cognitive strain, such as concept transfer, were facilitated relatively less for the "low" children. In addition, the children in the "low" intelligence group appeared to assimilate (utilize) proportionately more irrelevant cues from the total stimulus complex under task conditions but irrelevant cue utilization decreased relatively more, as compared to the higher intelligence groups under the incentive orientation (i.e., decreased attention span). Therefore, it would appear that incentive motivation has the potentiality for increasing cue utilization efficiency of "low" intelligence children on tasks that require spatial integration of environmental events. However, if performance efficiency requires relatively more temporal integration, a higher level of cognitive strain, incentive motivation has relatively less effect.

This investigation suggests several important areas for future research. First, the effects of incentive motivation on perceptual-cognitive proficiency of children of low average intelligence need considerably more systematic exploration. Certainly, both the object recognition and concept transfer data indicate these children are capable of increased capacity for achieving higher level perceptual-cognitive efficiency under appropriate incentive conditions. At the same time, the concept transfer task, which involved the more "complex" process of cue integration across time, appeared less susceptible to facilitation under the incentive condition. The differential effect of motivation on problems that require different degrees of cognitive strain should be a particularly fruitful area of research. Particular attention should be directed toward the discovery of the source of individual differences in the capacity for spatial and temporal integration. Such experiments might well reveal the extent to which appropriate programming of educational task requirements would facilitate learning in children of average and below average intelligence. While the general idea is not new to education (e.g., 49) too little systematic investigation of such environmental programming has been accomplished to date. The type of research suggested would provide some of the information necessary to maximize the "fit" between the information processing characteristics of children and learning tasks. Until such data are available, the idea of environmental programming will remain restricted to those areas of learning susceptible to machine control.

It was suggested that these results of the several experiments offered further confirmation of the "narrowed attention" hypothesis (16). A simple explanation of "attention" in terms of observing or orienting responses (8,39) does not suffice as an explanation of the selective cue utilization process that seems to be characteristic of the children on these tasks. The nature of the organizational processes, particularly the role of drive-related cue (affectivity) on the cue selection process, has important theoretical implication as well as the more practical one of adding to the information relevant to defining optimum task requirement for learning. The quality and extent of the effect of properties inherent in the stimulus situation (i.e., intrinsic motivational factor), in contrast to the incentive or extrinsic motivation on cue selection, for example, have been neglected so far as research in this area is concerned. Yet, the most cursory survey of the literature reveals clearly the dissimiliarity of task intrinsic and task extrinsic motivation on efficiency of cue utilization.

The question of the effects of intrinsic vs. extrinsic incentive on learning is a problem that deserves much more investigative attention in a variety of task-situations. It is clear on the basis of these data that extrinsic motivation can contribute to an improvement in perceptual-cognitive proficiency. The failure to achieve clear differential effects of the incentive condition at the different intelligence levels was contrary to our prediction. The absence of the expected effect may be attributed to several factors, but two of the most plausible explanations involve the questions of the motivational value of the incentives and the fact that the incentive was extrinsic to task performance. Relatively low intelligence, low socio-economic class and low achievement motivation are known to be positively correlated. Casual observation of the children during the selection of incentives, plus the correlation mentioned above, raises the question as to whether or not the procedures used in the experiment were sufficient to produce a level of motivational arousal in the lower "class" children that was characteristic of those of higher intelligence. The second question has theoretical as well as practical implications--are "extrinsic" incentives relatively less effective in improving the perceptual cognitive efficiency of the children of lower intelligence? It will be recalled that the "low" children performed less well on tasks where temporal integration of cues was required. If the children of "low" intelligence are characterized by relatively shorter "time perspective" and less capacity for temporal integration, the higher degree of cognitive strain associated with "extrinsic" incentive condition would be expected to reduce the effect of motivation on perceptual and cognitive activity.

Prior investigators of the effect of motivation on incidental learning have invariably reported a decrease in learning of incidental cues as motivational level is increased. The task used in this study was relatively "simple", but did require the formation of an association between the criterial and a contingent incidental cue during the classification learning phase. The facilitative effect of incentive motivation on concept transfer for the children of average and high intelligence levels indicates the task was, perhaps, of insufficient complexity for an adequate test of hypothesis concerning information processing capacity and motivation. The concept learning materials suggested by Hovland (79) can be arranged to provide systematic control of "information", i.e., the proportion of relevant to irrelevant cues. A study to determine whether incentive motivation simply reduces the amount of information utilized, or produces a selective utilization of cues, is currently under way.

The discussion of the results have centered primarily on implications for further research, rather than the educational process per se. The emphasis was deliberate. The question which must always be answered is--is there sufficient knowledge of the conditions under which the principles operate to generalize and test it in the "real-life" situation? A decision on this matter involves two types of risks. One may rush into the study of the principle in complex situation, spend time and effort, only to discover that too little is known of too many variables for any definitive conclusion on the problem. Or, one may continue in the process of determining the nature of the process under well-controlled conditions and ignore the potential application to education. The position of this investigator is somewhere between these extremes, but probably right of center.

The emphasis on research, rather than application, then is not because the principles inherent in these data have no educational implications. It is true the task situations appear far removed from classroom learning. Yet, shape and form perception, spatial-temporal integration, and incentive condition all have direct relevance to acquisition of reading skills. Experiments on the relation of these variables to rate of learning to reading await only a researcher's appropriate knowledge and ingenuity. The effect of incentive on concept formation and transfer, however, requires considerably more well-controlled investigation before generalizations can be made concerning the learning of concepts usually taught in science, biology or social sciences. The best we can hope for, it seems to me, is that interdisciplinary investigations (e.g., child psychologist, educational psychologist, and science educator) may accelerate the accumulation of the data which increases the fruitfulness of "applied" research.

REFERENCES

REFERENCES

1. Atteneave, F. Some informational aspects of visual perception. *Psychol. Rev.*, 1954, 61, 183-193.

2. Bahrick, H. P. Incidental learning under two incentive conditions. *J. exp. Psychol.*, 1954, 47, 170-172.

3. Bahrick. H. P., Fitts, P. M., & Rankin, R. E. Effects of incentives upon reactions to peripheral stimuli. *J. exp. Psychol.*, 1952, 44, 400-406.

4. Baker, C. H. Attention to visual displays during a vigilance task. I. Biasing attention. *Brit. J. Psychol.*, 1958, 49, 279-288.

5. Bartley, S. H. Localization of a simple form in an unstructured field. *Percept. mot. Skills*, 1959, 9, 44.

6. Basowitz, H., Persky, R., Korchin, S. J., & Brinher, R. R. *Anxiety and stress.* New York: McGraw-Hill, 1955.

7. Beier, E. G. The effect of induced anxiety on flexibility of intellectual functioning. *Psychol. Monogr.*, 1951, 65, 1-26.

8. Bender, M. B. The eye-centering system. *AMA Arch. Neurol. Psychiat.*, 1955, 73, 685-699.

9. Berlyne, D. E. Attention, perception, and behavior theory. *Psychol. Rev.*, 1951, 58, 127-146.

10. Bourne, L. E., & Pendleton, R. B. Concept identification as a function of completeness and probability of information feedback. *J. exp. Psychol.*, 1958, 56, 413-420.

11. Bowlby, J. Maternal care and mental health. *World Health Organiz. Monogr.*, 1951, No. 2.

12. Brown, G. H. Factors influencing incidental learning. *J. exp. Psychol.*, 1954, 47, 163-169.

13. Bruner, J. S., Matter, Jean & Papanek, Miriam L. Breadth of learning as a function of drive level and mechanization. *Psychol. Rev.*, 1955, 62, 1-10.

14. Bursill, A. E. The restriction of peripheral vision during exposure to hot and humid conditions. *Quart. J. exp. Psychol.*, 1958, 10, 113-129.

15. Callantine, Mary F., & Warren, J. M. Learning sets in human concept formation. *Psychol. Rep.*, 1955, 1, 363-367.

16. Callaway, E., & Dembo, E. Narrowed attention: a psychological phenomenon that accompanies a certain physiological change. *Arch. Neurol. Psychiat.*, 1958, 79, 74-90.

17. Callaway, E., & Thompson, S. V. Sympathetic activity and perception. *Psychosom. Med.*, 1953, 15, 443-445.

18. Campbell, D. T., & Gruen, W. Progression from simple to complex as a molar law of learning. *J. gen. Psychol.*, 1958, 59, 237-244.

19. Cattell, R. B. Anxiety, extraversion, and other second-order personality factors in children. *J. Pers.*, 1959, 27, 464-276.

20. Davids, A., & Oliver, Geraldine R. Learning, performance, and retention under stress in emotionally disturbed and normal children. *J. Pers.*, 1960, 28, 368-381.

21. Dember, W. N. *The psychology of perception.* New York: Henry Holt & Co., 1960.

22. Dodwell, P. C. Coding and learning in shape discrimination. *Psychol. Rev.*, 1961, 68, 373-382.

23. Easterbrook, J. A. The effect of emotion on cue utilization and the organization of behavior. *Psychol. Rev.*, 1959, 66, 183-201.

24. Eckstrand, G. A. Cue attention habits as a factor in training. *Tech. Rep. 6566*, W-P A.F.B., 1951.

25. Eysenck, H. J., Granger, G. W., & Brenglemann, J. C. *Perceptual processes and mental illness.* London: Chapman and Hall, 1957.

26. Gesell, A., Ilg, F., & Bullis, G. E. *Vision: its development in infant and child.* New York: Hoeber, 1949.

27. Gilchrist, K., & Nesberg, L. S. Need and perceptual change in need-related objects. *J. exp. Psychol.*, 1952, 44, 369-376.

28. Goldfarb, W. Emotional and intellectual consequences of psychologic deprivation in infancy: a reevaluation. In P. H. Hoch & J. Zubin (Eds.), *Psychopathology of childhood.* New York: Grune & Stratton, 1955.

29. Granger, G. W. Night vision and psychiatric disorders. *J. ment. Sci.*, 1957, 103, 48-79.

30. Granger, G. W. Personality and visual perception: a revision. *J. ment. Sci.*, 1953, 99, 8-43.

31. Guilford, J. P. *Personality*. New York: McGraw-Hill, 1959.

32. Harlow, H. F. The formation of learning sets. *Psychol. Rev.*, 1949, 56, 51-65.

33. Heath, D. H. Individual anxiety thresholds and their effect on intellectual performance. *J. abnorm. soc. Psychol.*, 1956, 52, 403-408.

34. Hebb, D. O. *The organization of behavior*. New York: Wiley, 1949.

35. Henle, Mary. Motivational influences on cognition. *Psychol. Rev.*, 1959, 66, 320.

36. Hodge, M. H. The influence of irrelevant information upon complex visual discrimination. *J. exp. Psychol.*, 1959, 57, 1-6.

37. Hunt, J. McV. *Experience and intelligence*. New York: Ronald Press, 1962.

38. Jones, A. The efficiency of utilization of visual information and the effects of stress. *J. exp. Psychol.*, 1959, 58, 428-432.

39. Kausler, D. H., & Trapp, E. P. Motivation and cue utilization in intentional and incidental learning. *Psychol. Rev.*, 1960, 6, 373-379.

40. Kephart, N. C. *The slow learner in the classroom*. Indianapolis: Charles E. Merrill, 1960.

41. Klein, G. S. Need and regulation. In M. R. Jones (Ed.), *Nebr. symposium on motivation*. Lincoln: Univ. Nebr. Press, 1957, 224-274.

42. Kreezer, G. L., *et al*. Attention: a bibliography and classification of the psychological literature. U.S.A.F., WADC Tech. Rep., 1954.

43. Lyle, W. H., & Smock, C. D. The relationship between manifest anxiety and test anxiety. *Proc. Iowa Acad. Sci.*, 1955, 62, 405-410.

44. Malpass, L. F., Mark, S., & Palermo, D. S. Responses of retarded children to the children's manifest anxiety scale. *J. educ. Psychol.*, 1960, 51, 305-308.

45. Malpass, L. F., Atkinson, C. J., & Goldiamond, I. Perceptual and response abilities of mentally retarded children. U.S. Office of Educ., Co-op Project No. 176, 1960.

46. Mandler, G., & Sarason, S. B. A study of anxiety and learning. *J. abnorm. soc. Psychol.*, 1952, 47, 166-173.

47. McPherson, Marion W. A survey of experimental studies of learning in individuals who achieve subnormal ratings on standardized psychometric procedures. *Amer. J. ment. Defic.*, 1948, 52, 232-254.

48. Moffitt, J. W., & Stagner, R. Perceptual rigidity and closure as functions of anxiety. *J. abnorm. soc. Psychol.*, 1956, 52, 354-357.

49. Montessori, Maria. *The Montessori method.* London: Rutledge, 1912.

50. Neimark, E., & Saltzman, I. J. Intentional and incidental learning with different rates of stimulus-presentation. *Amer. J. Psychol.*, 1953, 66, 618-621.

51. Newbrough, J. R. Interaction between total stimulus information and specific stimulus information on visual recognition. *J. exp. Psychol.*, 1958, 55, 297-300.

52. Piaget, J. *The psychology of intelligence.* London: Roulledge & Paul, 1950.

53. Plenderleith, Mavis, & Postman, L. Individual differences in intentional and incidental learning. *Brit. J. Psychol.*, 1957, 48, 241-248.

54. Postman, L., & Adams, Pauline A. Studies in incidental learning: IV. The interaction of orienting tasks and stimulus materials. *J. exp. Psychol.*, 1956, 51, 329-333.

55. Postman, L., & Adams, Pauline A. Studies in incidental learning: VIII. The effects of contextual determination. *J. exp. Psychol.*, 1960, 59, 153-164.

56. Quartermain, D., & Scott, T. H. Incidental learning in a simple task. *Canad. J. Psychol.*, 1960, 14, 175-182.

57. Quartermain, D., & Mangan, G. Role of relevance in incidental learning of verbal material. *Percept. mot. Skills*, 1959, 9, 255-258.

58. Reichard, S., Schneider, M., & Rapaport, D. The development of concept formation in children. *Amer. J. Orthopsychiat.*, 1944, 14, 156-161.

59. Rubin, B. M., Shantz, D. W., & Smock, C. D. Perceptual constriction as a function of incentive motivation. *Percept. mot. Skills*, 1962, [illegible]

60. Sackett, R. S. The influence of symbolic rehearsal upon the retention of a maze habit. *J. gen. Psychol.*, 1934, 10, 376-398.

61. Sanders, R., & Pacht, A. R. Perceptual size constancy of known clinical groups. *J. consult. Psychol.*, 1954, 53, 381-385.

62. Sarason, I. G. Intellectual and personality correlates of test anxiety. *J. abnorm. soc. Psychol.*, 1959, 59, 272-275.

63. Sartain, A. Q. The conception of the true path and efficiency in maze learning. *J. exp. Psychol.*, 1940, 26, 74-93.

64. Scott, T. C. Imagery--to what extent is it a function of the maze pattern? *J. genet. Psychol.*, 1936, 49, 271-278.

65. Shantz, D. W., Rubin, B. M., & Smock, C. D. Utilization of visual information as a function of incentive motivation. *Percept. mot. Skills*, 1962, in press.

66. Shaw, W. A. Facilitating effects of induced tension upon the perception span for digits. *J. exp. Psychol.*, 1956, 51, 113-117.

67. Shellow, R. S. Perceptual distortion in the spatial localization of emotionally meaningful stimuli. *Dissert. Abstr.*, 1956, 16, 2529.

68. Shipley, T. E. Threat to the self, the direction and breadth of attention and the distance gradient. *Dissert. Abstr.*, 1956, 16, 1930.

69. Shore, M. F. Perceptual efficiency as related to induced muscular effort and manifest anxiety. *J. exp. Psychol.*, 1958, 55, 179-183.

70. Shyzman, V. Constriction of the perceptual field under stress. Abstract of M.A. Thesis read at EPA, 1955.

71. Siegel, S. M. Discrimination among mental defective, normal, schizophrenic and brain damaged subjects on the visual-verbal concept formation test. *Amer. J. ment. Defic.*, 1957, 62, 338-343.

72. Silverman, R. E., & Blitz, B. Learning and two kinds of anxiety. *J. abnorm. soc. Psychol.*, 1956, 52, 301-303.

73. Singer, J. L. Personal and environmental determinants of perception in a size constancy experiment. *J. exp. Psychol.*, 1952, 43, 420-427.

74. Smock, C. D. The influence of psychological stress on the "intolerance of ambiquity." *J. abnorm. soc. Psychol.*, 1955, 50, 177-182.

75. Smock, C. D. The influence of stress on the perception of incongruity. *J. abnorm. soc. Psychol.*, 1955, 50, 354-356.

76. Smock, C. D. Some current research and thinking about cognitive processes in children: a symposium. *Merritt Palmer quart. J. Behav. Developm.*, 1960, 4, 243-249.

77. Smock, C. D., & Holt, B. D. Children's reactions to novelty: an experimental study of curiosity motivation. *Child Developm.*, 1962, 33, 631-642.

78. Smock, C. D., & Small, V. H. Efficiency of utilization of visual information as a function of induced muscular tension. *Percept. mot. Skills*, 1962, in press.

79. Smock, C. D., & Lange, R. Variety of experience and breadth of social schemata. Mimeo. paper, 1962.

80. Smock, C. D., & Rubin, B. M. Utilization of visual information in children as a function of incentive motivation. *Child Developm.*, 1962, in press.

81. Solley, C. M., Jr. Problem-solving difficulty as a function of deviation of "meaning" of physical cues from expected "meaning." *J. gen. Psychol.*, 1961, in press.

82. Spence, K. W., & Lippitt, R. An experimental test of the sign-gestalt theory of trial and error learning. *J. exp. Psychol.*, 1946, 36, 491-502.

83. *SRA. Manual of directions for the SRA tests of educational ability.* Chicago: Science Research Assoc., 1958.

84. Stevenson, H. W. Latent learning in children. *J. exp. Psychol.*, 1954, 47, 17-21.

85. Stevenson, H. W., & Snyder, Lelia C. Performance as a function of the interaction of incentive conditions. *J. Pers.*, 1960, 28, 1-11.

86. Stevenson, H. W., & Swartz, J. D. Learning set in children as a function of intellectual level. *J. comp. physiol. Psychol.*, 1958, 51, 755-757.

87. Stevenson, H. W., & Zigler, E. F. Probability learning in children. *J. exp. Psychol.*, 1958, 56, 185-192.

88. Tolman, E. C. Cognitive maps in rats and men. *Psychol. Rev.*, 1948, 55, 189-208.

89. Vinache, W. E. *The psychology of thinking*. New York: McGraw-Hill, 1952.

90. Waite, R. R., Sarason, S. B., Lighthall, F. F., & Davidson, K. S. A study of anxiety and learning in children. *J. abnorm. soc. Psychol.*, 1958, 57, 267-270.

91. Wallach, M. A., & Caron, A. J. Attribute criteriality and sex-linked conservatism as determinants of psychological similarity. *J. abnorm. soc. Psychol.*, 1959, 59, 43-50.

92. Wechsler, D. *Wechsler intelligence scale for children.* New York: Psychol. Corp., 1949.

93. Werner, H. The concept of development from a comparative and organismic point of view. In D. B. Harris (Ed.), *The concept of development: an issue in the study of human behavior.* Minnesota: Univ. of Minn., 1957.

94. Winnick, Wilma A. Transfer of set in incidental learning. *Amer. J. Psychol.*, 1958, 71, 399-403.

95. Woodrow, H. The measurement of attention. *Psychol. Monogr.*, 1914, 17, 76.

96. Youngquist, O., & Smock, C. D. The effect of reinforcement combinations on acquisition and utilization of social schemata. Mimeo. paper, 1962.

97. Zigler, E. F., Hodgden, L., & Stevenson, H. W. The effects of support and non-support on the performance of normal and feebleminded children. *J. Pers.*, 1958, 26, 106-122.

Appendix Figure 1 (description)

The Mobile Psychological Laboratory is divided into three main sections: an experimental testing room, experimenter's control and recording room, and an interview-data analysis room.

Twenty-one 50-watt incandescent lamps provide indirect lighting in the windowless experimental room. A 3' x 3' screen is located on the end wall opposite the experimenter's room, while an aperture for a projector lens and a one-way window (20" x 24") are located in the wall between the control room and the testing room.

The room houses the following apparatus: a Sarkes Tarzian 35 mm. automatic slide projector with an electrically controlled Alphax Synchromatic shutter capable of presenting up to 50 visual displays; variac controls for the light intensity of the projector and the experimental room; Hunter timers for control of the stimuli presentation, response recording, and reinforcement sequencing; a chronoscope for recording response latency; a program display panel which permits E to monitor the visual displays, and a two-way intercom system.

A control board located in front of the one-way window permits the experimenter to follow the progress of the experimental cycle (the on-set of each step is indicated by a small light). It also permits him to interrupt and/or control this cycle at any one of a number of points by means of on-off switches.

The experimental observation and interviewing rooms are described in Figure 1, Appendix A, p. 109.

APPENDIX A

Figure 1

Purdue Mobile Psychological Laboratory

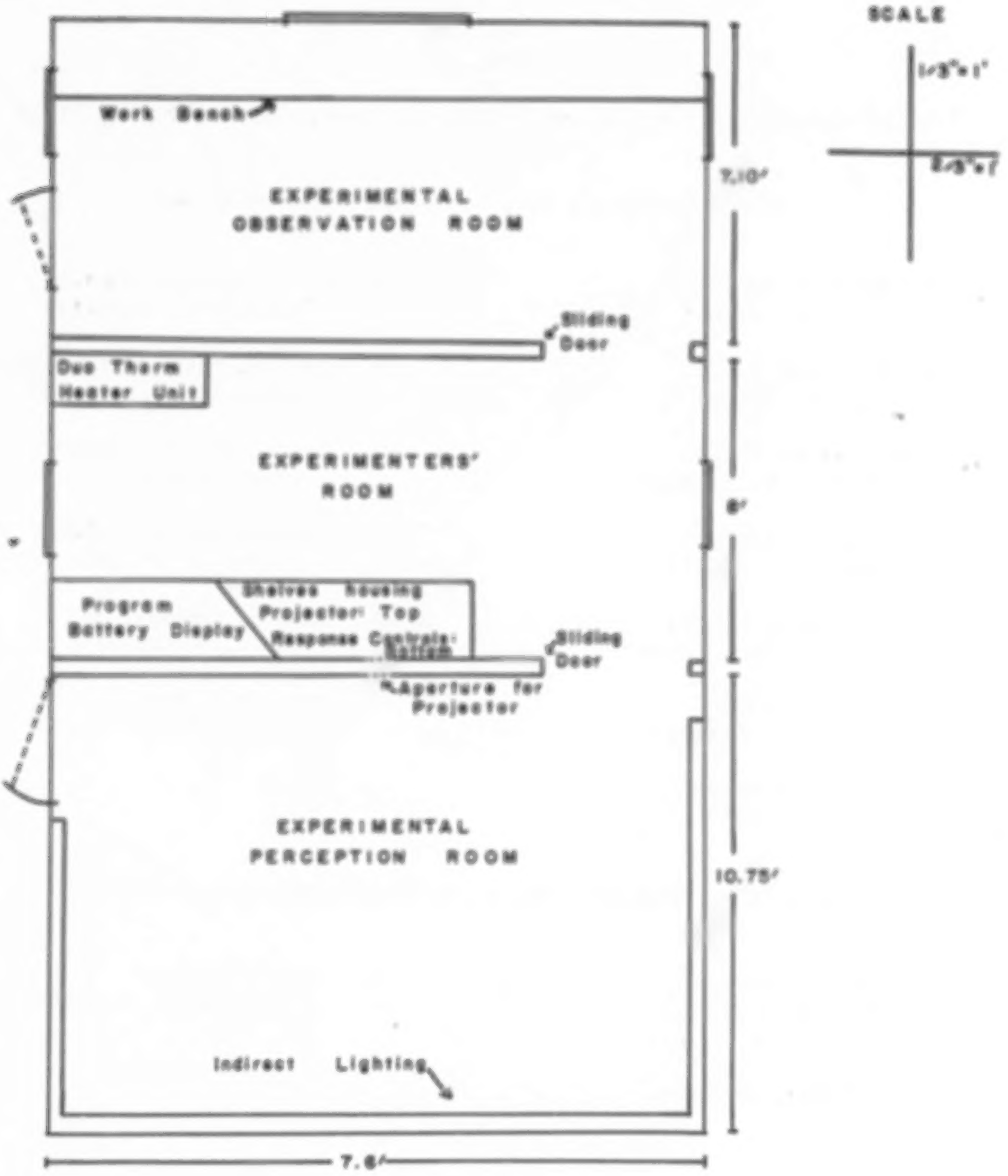


Table 1

List of Elementary Schools and Principals Participating in the Study

*Wayne Township: Mr. F. Kline, Superintendent

1. Bridgeport School
   (Frank E. Cline)
2. Maple Grove School
   (Paul A. Fitch)
3. James Robey School
   (Charles D. Fansler)
4. Westlake School
   (Everett F. Bell)
5. Lora Rhoades School
   (Russell S. Fordyce)
6. Flackville School
   (Gordon E. Harker)
7. Garden City School
   (Mr. Michaels)
8. A. L. Sanders School
   (Claude E. Tyndall)
9. Mary M. McClelland School
   (Mary M. McClelland)
10. Drexel Gardens School
    (Paul Calabro)
11. Fleming Garden School
    (Grant Stratton)
12. Maywood School
    (C. E. Jenkins)
13. Mars Hill School
    (Orvel Hendrickson)

Lafayette, Indiana: Mr. J. R. Hiatt, Superintendent

1. Washington School
   (Morris C. Etter)
2. Edgelea School
   (William E. Jackson)

*Marion County, Indiana

Table 2

Means and Standard Deviations of TEA Subscores and Total Score

for Subjects in Total Sample

School		Subtest			
		L	R	Q	Total
1	Boys	$\bar{X}$ = 26.23	$\bar{X}$ = 18.80	$\bar{X}$ = 26.23	$\bar{X}$ = 71.26
		s = 8.85	s = 4.21	s = 12.09	s = 21.47
	Girls	$\bar{X}$ = 25.57	$\bar{X}$ = 17.26	$\bar{X}$ = 28.21	$\bar{X}$ = 71.05
		s = 7.72	s = 3.66	s = 6.88	s = 15.36
2	Boys	$\bar{X}$ = 28.26	$\bar{X}$ = 19.56	$\bar{X}$ = 21.50	$\bar{X}$ = 69.32
		s = 8.17	s = 3.27	s = 7.04	s = 12.70
	Girls	$\bar{X}$ = 27.15	$\bar{X}$ = 19.98	$\bar{X}$ = 22.27	$\bar{X}$ = 69.41
		s = 9.88	s = 3.93	s = 6.96	s = 17.13
3	Boys	$\bar{X}$ = 29.26	$\bar{X}$ = 19.52	$\bar{X}$ = 22.59	$\bar{X}$ = 71.37
		s = 8.27	s = 4.41	s = 8.64	s = 16.40
	Girls	$\bar{X}$ = 32.33	$\bar{X}$ = 20.44	$\bar{X}$ = 26.22	$\bar{X}$ = 79.00
		s = 8.45	s = 3.36	s = 5.74	s = 12.20
4	Boys	$\bar{X}$ = 29.79	$\bar{X}$ = 20.70	$\bar{X}$ = 25.68	$\bar{X}$ = 76.18
		s = 8.56	s = 2.71	s = 7.31	s = 14.36
	Girls	$\bar{X}$ = 31.57	$\bar{X}$ = 20.83	$\bar{X}$ = 25.14	$\bar{X}$ = 77.69
		s = 9.17	s = 4.07	s = 7.41	s = 17.35
5	Boys	$\bar{X}$ = 29.51	$\bar{X}$ = 19.67	$\bar{X}$ = 22.15	$\bar{X}$ = 71.33
		s = 10.66	s = 3.47	s = 7.69	s = 16.38
	Girls	$\bar{X}$ = 31.57	$\bar{X}$ = 18.93	$\bar{X}$ = 26.00	$\bar{X}$ = 76.50
		s = 8.94	s = 3.66	s = 6.88	s = 15.81
6	Boys	$\bar{X}$ = 27.45	$\bar{X}$ = 18.90	$\bar{X}$ = 23.18	$\bar{X}$ = 69.53
		s = 9.95	s = 3.87	s = 8.32	s = 17.89
	Girls	$\bar{X}$ = 26.69	$\bar{X}$ = 19.54	$\bar{X}$ = 23.64	$\bar{X}$ = 69.87
		s = 10.14	s = 4.62	s = 8.07	s = 18.41
7	Boys	$\bar{X}$ = 26.43	$\bar{X}$ = 19.03	$\bar{X}$ = 20.53	$\bar{X}$ = 66.00
		s = 9.41	s = 3.33	s = 8.66	s = 17.25
	Girls	$\bar{X}$ = 27.58	$\bar{X}$ = 20.47	$\bar{X}$ = 25.63	$\bar{X}$ = 73.68
		s = 9.13	s = 2.72	s = 4.88	s = 12.05
8	Boys	$\bar{X}$ = 24.40	$\bar{X}$ = 18.35	$\bar{X}$ = 19.65	$\bar{X}$ = 62.40
		s = 10.65	s = 5.02	s = 7.96	s = 15.60
	Girls	$\bar{X}$ = 23.48	$\bar{X}$ = 18.35	$\bar{X}$ = 22.25	$\bar{X}$ = 64.10
		s = 7.90	s = 3.29	s = 7.53	s = 4.83
9	Boys	$\bar{X}$ = 26.98	$\bar{X}$ = 19.82	$\bar{X}$ = 23.29	$\bar{X}$ = 70.09
		s = 9.72	s = 3.73	s = 8.15	s = 16.15
	Girls	$\bar{X}$ = 29.14	$\bar{X}$ = 20.08	$\bar{X}$ = 25.43	$\bar{X}$ = 74.65
		s = 9.09	s = 2.86	s = 6.31	s = 14.39

(continued)

Table 2 (continued)

Means and Standard Deviations of TEA Subscores and Total Score for Subjects in Total Sample

School		Subtest L	R	Q	Total
10	Boys	$\bar{X} = 19.73$ $s = 7.95$	$\bar{X} = 17.85$ $s = 3.60$	$\bar{X} = 23.88$ $s = 5.99$	$\bar{X} = 61.46$ $s = 11.46$
	Girls	$\bar{X} = 25.05$ $s = 9.95$	$\bar{X} = 17.82$ $s = 4.31$	$\bar{X} = 24.06$ $s = 9.71$	$\bar{X} = 66.94$ $s = 18.03$
11	Boys	$\bar{X} = 26.50$ $s = 7.96$	$\bar{X} = 19.30$ $s = 4.28$	$\bar{X} = 21.35$ $s = 4.75$	$\bar{X} = 67.15$ $s = 11.02$
	Girls	$\bar{X} = 27.82$ $s = 10.67$	$\bar{X} = 19.23$ $s = 3.31$	$\bar{X} = 23.35$ $s = 7.83$	$\bar{X} = 70.41$ $s = 19.23$
12	Boys	$\bar{X} = 28.71$ $s = 7.96$	$\bar{X} = 19.71$ $s = 3.15$	$\bar{X} = 25.18$ $s = 6.64$	$\bar{X} = 73.59$ $s = 14.50$
	Girls	$\bar{X} = 31.00$ $s = 9.51$	$\bar{X} = 20.13$ $s = 4.10$	$\bar{X} = 38.47$ $s = 4.27$	$\bar{X} = 79.60$ $s = 14.35$
13	Boys	$\bar{X} = 30.94$ $s = 8.22$	$\bar{X} = 20.06$ $s = 3.53$	$\bar{X} = 25.55$ $s = 7.14$	$\bar{X} = 76.55$ $s = 15.94$
	Girls	$\bar{X} = 27.41$ $s = 8.31$	$\bar{X} = 20.24$ $s = 3.75$	$\bar{X} = 25.32$ $s = 12.23$	$\bar{X} = 72.97$ $s = 19.59$

3

Table 3

List of Incentives Used

1. pearl necklace
2. puzzles
3. barrettes
4. comic books
5. checkers
6. airplane models
7. broaches
8. Kentucky Derby racing game
9. Golden books
10. purse
11. waterfall puzzle
12. water pistol
13. ball
14. atomizer
15. Old Maid game
16. candy bars

APPENDIX B

Figure 1

Stimuli and Representative Visual Displays for Complex Form Recognition

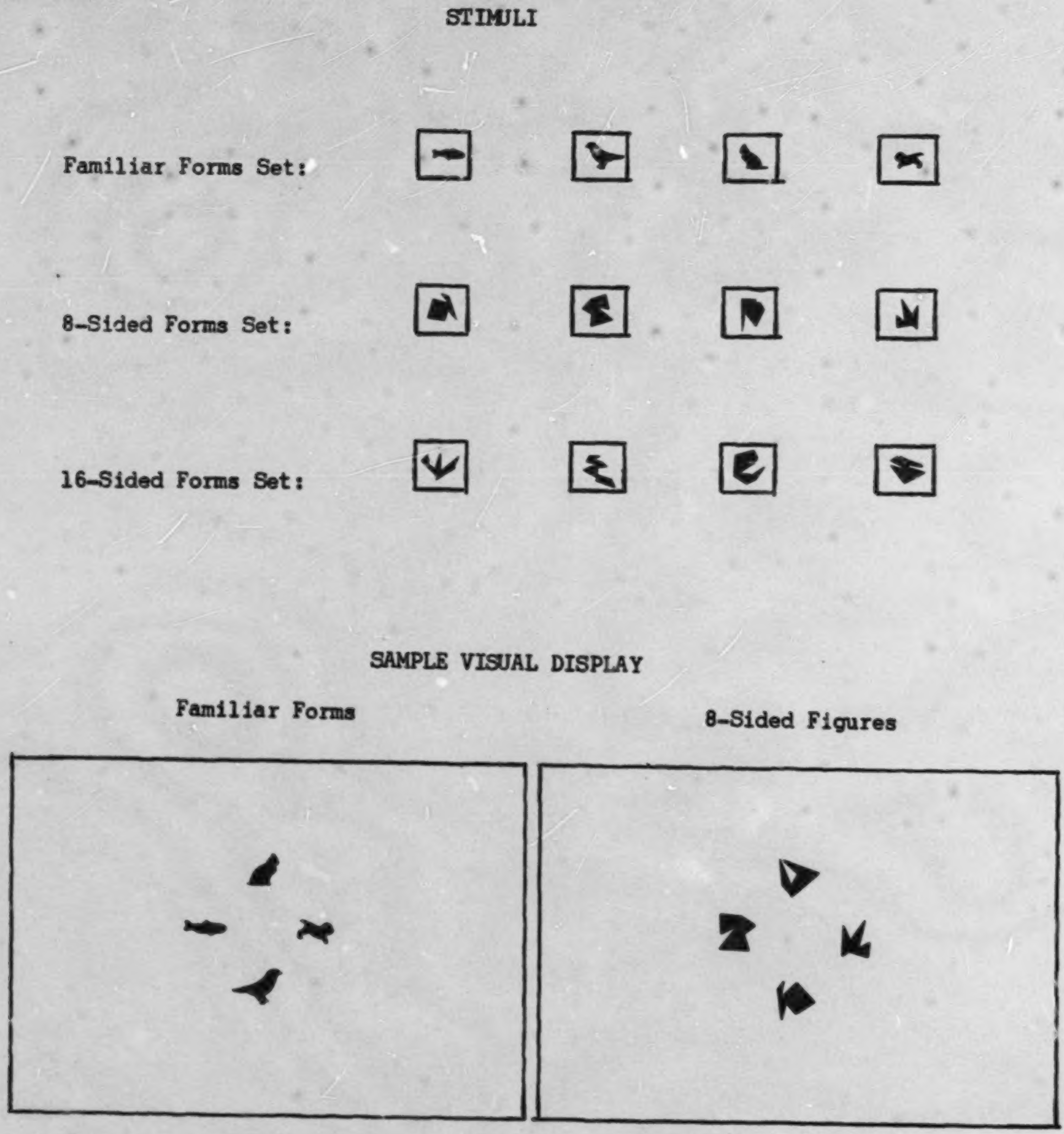


Table 1

Target Stimuli and Stimulus Location for Each Trial in Complex Form Recognition

Trial	Target	Location[1]	Trial	Target	Location
1	Bird	Top (Practice)	20	16-Sided	Bottom
2	8-Sided	Top (Practice)	21	Bird	Top
3	Cat	Left	22	8-Sided	Bottom
4	8-Sided	Right	23	16-Sided	Bottom
5	16-Sided	Top	24	Dog	Top
6	Bird	Bottom	25	8-Sided	Right
7	8-Sided	Bottom	26	16-Sided	Left
8	16-Sided	Top	27	Fish	Left
9	Cat	Bottom	28	8-Sided	Right
10	8-Sided	Right	29	16-Sided	Top
11	16-Sided	Right	30	Bird	Bottom
12	Fish	Top	31	8-Sided	Bottom
13	8-Sided	Left	32	16-Sided	Top
14	16-Sided	Left	33	Dog	Bottom
15	Dog	Left	34	8-Sided	Right
16	8-Sided	Left	35	16-Sided	Right
17	16-Sided	Top	36	Fish	Top
18	Cat	Right	37	8-Sided	Left
19	8-Sided	Right	38	16-Sided	Left

[1] Top, Bottom, Left, Right (see Figure 2, p. 14).

Table 2

Analysis of Variance of Recognition Accuracy and Decision Certainty Under the Different Experimental Conditions

		Accuracy		Certainty	
Source	df	MS	F	MS	F
Between Subjects	91				
Intelligence (I)	2	106.48	7.60**	25.73	
Motivation (M)	1	.21		250.74	5.33**
Order (O)	1	36.90	2.63+	11.22	
I x M	2	.49		45.42	
I x O	2	2.99		122.43	2.61+
M x O	1	11.90		9.94	
I x M x O	2	.58		99.41	2.12
Residual (b)	80	14.01		47.01	
Within Subjects	460				
Session (S)	1	205.79	90.81**	771.27	113.34**
I x S	2	4.08	1.80	2.61	
M x S	1	11.74	5.18*	62.84	9.25**
O x S	1	15.82	6.98**	19.22	2.83+
I x M x S	2	5.90	2.61+	12.93	1.90
I x O x S	2	.93		.48	
M x O x S	1	.19		.95	
I x M x O x S	2	3.82	1.69	8.72	1.28
Residual (w_1)	80	2.27		6.79	
Form (F)	2	141.72	59.05**	716.15	82.33**
I x F	4	.64		10.55	1.21
M x F	2	1.07		16.86	1.94
O x F	2	.55		16.79	1.93
I x M x F	4	3.70	1.54	8.99	1.03
I x O x F	4	1.41		2.75	
M x O x F	2	2.20		.06	
I x M x O x F	4	.68		4.60	
Residual (w_2)	160	2.40		8.70	
Session x Form	2	6.79	1.47	23.54	1.16
I x S x F	4	.45		5.90	
M x S x F	2	1.96		10.43	
O x S x F	2	.09		.41	
I x M x S x F	4	1.37		5.29	
I x O x S x F	4	5.49	1.19	3.37	
M x O x S x F	2	1.73		7.36	
I x M x O x S x F	4	2.85		2.94	
Residual (w_3)	160	4.62		20.27	

+ Significant at .10 level
* Significant at .05 level
** Significant at .01 level

Table 3

Analysis of Variance of Decision Time Under the Different Experimental Conditions[1]

Source	df	MS	F
Between Subjects	51		
Intelligence (I)	2	320429.91	
Motivation (M)	1	1626944.06	
Order (O)	1	1297095.64	
I x M	2	2813465.65	1.07
I x O	2	1431927.09	
M x O	1	101553.09	
I x M x O	2	1696231.71	
Residual (b)	40	2641782.14	
Within Subjects	260		
Session (S)	1	9906241.90	38.39**
I x S	2	370982.27	1.44
M x S	1	800081.25	3.10+
O x S	1	117129.75	
I x M x S	2	45212.84	
I x O x S	2	199969.29	
M x O x S	1	463953.79	1.80
I x M x O x S	2	264798.09	1.03
Residual (w_1)	40	258024.11	
Form (F)	2	3697828.12	37.38**
I x F	4	206477.39	2.09
M x F	2	145309.88	1.47
O x F	2	146182.32	1.48
I x M x F	4	64605.11	
I x O x F	4	103273.57	
M x O x F	2	105979.62	
I x M x O x F	4	29404.27	
Residual (w_2)	80	989283.76	
Session x Form	2	375776.39	1.13
I x S x F	4	135330.07	
M x S x F	2	95967.20	
O x S x F	2	26985.01	
I x M x S x F	4	106669.87	
I x O x S x F	4	105160.90	
M x O x S x F	2	26244.80	
I x M x O x S x F	4	43651.95	
Residual (w_3)	80	332565.75	

+ Significant at .10 level
* Significant at .05 level
** Significant at .01 level

[1] Decision times were recorded to nearest 100th second, but decimal points were disregarded in the analysis of variance.

APPENDIX C

Table 1

The Order of Presentation of the Four Levels of Complexity and the Four Dimensions Through the Entire Experimental Procedure

Problem Set 1				Problem Set 2			
Trial	Sides	Dimension	Position of Diff. Figure	Trial	Sides	Dimension	Position of Diff. Figure
1	16	Compactness	5	1	12	Symmetry	2
2	12	Rotation	3	2	4	Elongation	1
3	8	Elongation	3	3	16	Rotation	6
4	16	Symmetry	1	4	12	Elongation	2
5	16	Elongation	2	5	12	Compactness	5
6	8	Rotation	5	6	4	Rotation	4
7	4	Symmetry	1	7	8	Compactness	1
8	12	Symmetry	5	8	16	Symmetry	2
9	13	Compactness	3	9	4	Symmetry	3
10	16	Rotation	1	10	16	Elongation	6
11	4	Rotation	5	11	16	Compactness	3
12	4	Compactness	3	12	8	Symmetry	2
13	12	Compactness	3	13	12	Rotation	6
14	12	Elongation	1	14	4	Compactness	5
15	4	Elongation	5	15	8	Rotation	3
16	8	Symmetry	5	16	8	Elongation	6
17	8	Compactness	5	17	8	Symmetry	3
18	12	Compactness	6	18	12	Rotation	4
19	16	Rotation	3	19	16	Elongation	2
20	12	Symmetry	3	20	8	Rotation	6
21	12	Elongation	5	21	4	Elongation	4
22	16	Compactness	6	22	4	Compactness	5
23	12	Rotation	1	23	4	Symmetry	4
24	4	Rotation	6	24	12	Compactness	2
25	8	Elongation	2	25	8	Elongation	4
26	4	Elongation	3	26	12	Elongation	3
27	4	Compactness	2	27	16	Compactness	4
28	16	Elongation	3	28	8	Compactness	2
29	16	Symmetry	6	29	16	Rotation	4
30	8	Symmetry	4	30	16	Symmetry	5
31	4	Symmetry	5	31	12	Symmetry	1
32	8	Rotation	2	32	4	Rotation	3

Position of "Different" Figure: (1) Stimulus in lower left, (2) upper left, (3) lower center, (4) upper center, (5) lower right, (6) upper right.

Table 2

Analysis of Variance of Recognition Efficiency Scores for Tachistoscopic (Method A) and Scanning (Method B) Procedures

		Method A Recognition Error		Method B Decision Time	
Source	df	MS	F	MS	F
Between Subjects	47				
Intelligence (I)	2	2.07	1.95	171.92	5.75*
Order (O)	1	6.02	5.67*	402.14	13.44*
Problem (P)	1	.13		86.10	2.21
I x O	2	.61		39.70	1.33
I x P	2	.06		34.70	1.16
O x P	1	.63		6.40	
I x O x P	2	.45		58.76	1.96
Residual (b)	36	1.06		29.93	
Within Subjects	720				
Sides (S)	3	.41		9.69	6.17**
I x S	6	.70	2.36*	.40	
O x S	3	.13		1.01	
P x S	3	3.15	10.69**	6.84	4.36**
I x O x S	6	.66	2.22*	1.75	1.11
I x P x S	6	.45	1.54	1.95	1.24
O x P x S	3	1.00	3.37*	.48	
I x O x P x S	6	.25		2.60	1.65
Residual (w_1)	108	.30		1.57	
Dimensions (D)	3	4.02	13.64**	16.76	11.22*
I x D	6	.13		1.60	1.07
O x D	3	.08		6.28	4.20*
P x D	3	3.31	11.21**	7.17	4.80*
I x O x D	6	.12		.73	
I x P x D	6	.05		1.05	
O x P x D	3	.04		.43	
I x O x P x D	6	.18		1.40	
Residual (w_2)	108	.30		1.50	
Sides x Dimensions	9	.83	2.04*	4.91	3.46**
I x S x D	18	.43	1.05	1.98	1.40
O x S x D	9	.18		.82	
P x S x D	9	2.07	5.10**	8.33	5.88**
I x O x S x D	18	.22		1.45	1.02
I x P x S x D	18	.50	1.22	1.58	1.11
O x P x S x D	9	.53	1.31	3.43	2.42*
I x O x P x S x D	18	.35		1.58	1.12
Residual (w_3)	324	.41		1.42	

+ Significant at .10 level

* Significant at .05 level

** Significant at .01 level

Table 3

Newman-Keuls Test of Differences Between Ordered Means of Recognition Errors for the Tachistoscopic Procedure

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
4C	12E	8C	16C	4E	12C	4S	16E	8E	8R	8S	12R	16R	16S	4R	12S

Table of Differences

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	
1		5	9	14	16	16	17	19	19	19	22*	24*	24*	26*	29*	29*	r-16
2			4	9	11	11	12	14	14	14	17	19	19	21*	24*	24*	r-15
3				5	7	7	8	10	10	10	13	15	15	17	20	20	r=14
4					2	2	3	5	5	5	8	10	10	12	15	15	r=13
5						0	1	3	3	3	6	8	8	10	13	13	r=12
6							1	3	3	3	6	8	8	10	13	13	r=11
7								2	2	2	5	7	7	9	12	12	r=10
8									0	0	3	5	5	7	10	10	r=9
9										0	3	5	5	7	10	10	r=8
10											3	5	5	7	10	10	r=7
11												2	2	4	7	7	r=6
12													0	2	5	5	r=5
13														2	5	5	r=4
14															3	3	r=3
15																0	r=2
16																	

Ordered Mean Differences for Sides x Dimensions

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
4C	12E	8C	16C	4E	12C	4S	16E	8E	8R	8S	12	16R	16S	4R	12S

Any scores not underlined by the same line are significantly different.

Any scores underlined by the same line are not significantly different.

Table 4

Analysis of Variance of Decision Time for Tachistoscopic Procedure

(Method A) Under the Different Experimental Conditions

Source	df	MS	F
Between Subjects	47		
Intelligence (I)	2	2.14	
Order (O)	1	35.85	2.48
Problem (P)	1	1.41	
I x O	2	41.18	2.85
I x P	2	.40	
O x P	1	10.56	
I x O x P	2	12.31	
Residual (b)	36	14.45	
Within Subjects	720		
Sides (S)	3	4.92	3.64**
I x S	6	2.14	1.58
O x S	3	1.64	1.21
P x S	3	3.76	2.77
I x O x S	6	2.84	2.10
I x P x S	6	1.86	1.38
O x P x S	3	.39	
I x O x P x S	6	4.86	3.59**
Residual (w_1)	108	1.35	
Dimensions (D)	3	9.29	4.00*
I x D	6	1.77	
O x D	3	4.24	1.83
P x D	3	7.11	3.06*
I x O x D	6	.68	
I x P x D	6	2.47	1.06
O x P x D	3	.85	
I x O x P x D	6	2.37	1.02
Residual (w_2)	108	2.32	
Sides x Dimensions	9	2.07	
I x S x D	18	1.68	
O x S x D	9	2.53	1.21
P x S x D	9	5.49	2.62**
I x O x S x D	18	1.85	
I x P x S x D	9	3.70	1.77
O x P x S x D	18	2.06	
I x P x O x S x D	18	2.01	
Residual (w_3)	324	2.09	

+ Significant at .10 level
* Significant at .05 level
** Significant at .01 level

Table 5

Newman-Keuls Test of Differences Between Ordered Means of Decision Time for the Scanning Procedure

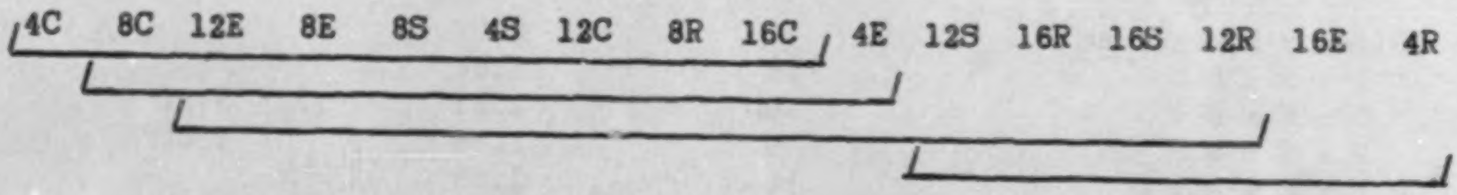
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
4C 1.93	8C 1.97	12E 2.16	8E 2.19	8S 2.26	4S 2.26	12C 2.27	8R 2.28	16C 2.30	4E 2.32	12S 2.37	16R 2.41	16S 2.41	12R 2.49	16E 2.65	4R 2.68

Table of Differences

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	
1		.03	.22	.25	.33	.33	.33	.35	.37	.39*	.43*	.47*	.47*	.56*	.72*	.74*	r=16
2			.19	.22	.29	.29	.30	.32	.33	.35	.40*	.44*	.44*	.52*	.69*	.71*	r=15
3				.03	.10	.11	.11	.13	.15	.17	.21	.25	.25	.33	.50*	.52*	r=14
4					.07	.07	.08	.10	.11	.13	.18	.22	.22	.31	.47*	.49*	r=13
5						.00	.01	.02	.04	.05	.11	.15	.15	.24	.40*	.42*	r=12
6							.01	.02	.04	.05	.11	.15	.15	.24	.39*	.42*	r=11
7								.02	.03	.04	.10	.14	.14	.23	.39*	.41*	r=10
8									.02	.03	.08	.12	.12	.22	.37*	.39*	r=9
9										.01	.07	.11	.11	.20	.35	.38*	r=8
10											.06	.11	.10	.19	.34	.37*	r=7
11												.04	.04	.13	.29	.31	r=6
12													.00	.09	.25	.27	r=5
13														.09	.25	.27	r=4
14															.16	.18	r=3
15																.02	r=2
16																	

Ordered Mean Differences for Sides x Dimensions

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16



Any scores not underlined by the same line are significantly different.

Any scores underlined by the same line are not significantly different.

Table 6

Analysis of Variance of Recognition Efficiency Scores for Tachistoscopic (Method A) and Scanning (Method B) Procedures

(Practice Effect)

		Method A		Method B	
		Recognition Error		Decision Time	
Source	df	MS	F	MS	F
Between Subjects	47				
Intelligence (I)	2	4.33	2.00	21.78	6.09**
Order (O)	1	11.69	5.40*	47.50	13.28**
Problem (P)	1	.32		11.38	3.18+
I x O	2	1.33		4.40	1.23
I x P	2	.16		4.03	1.13
O x P	1	.94		.77	
I x O x P	2	1.07		7.59	2.12
Residual (b)	36	2.17		3.58	
Within Subjects	336				
Trials (T)	7	3.98	4.94**	2.01	8.97**
I x T	14	.72		.13	
O x T	7	.37		.58	2.61**
P x T	7	7.18	8.92**	.87	3.89**
I x O x T	14	.62		.14	
I x P x T	14	1.33	1.65+	.23	1.03
O x P x T	7	.21		.34	1.54+
I x O x P x T	14	.30		.19	
Residual (w)	252	.81		.22	

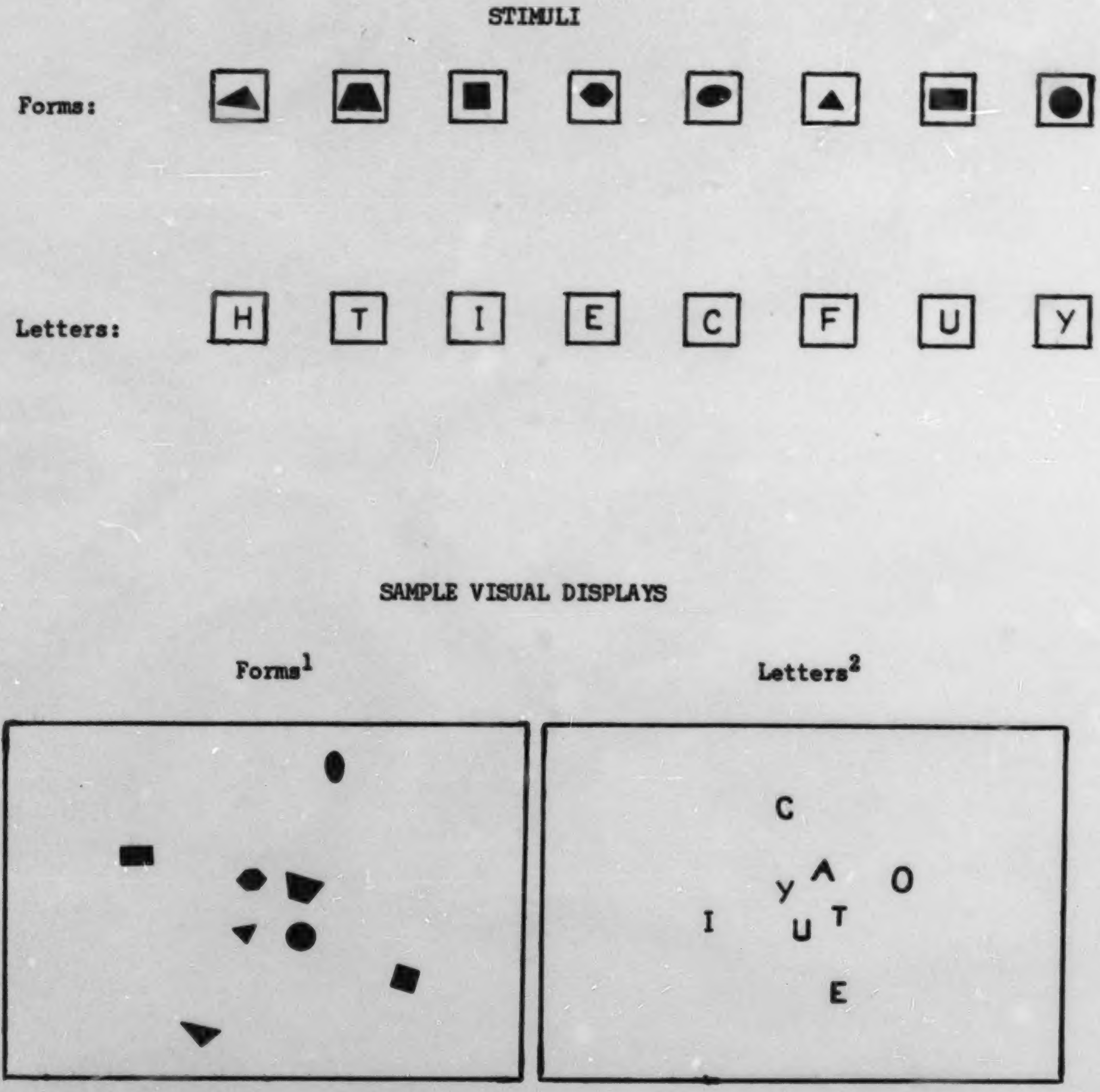
+ Significant at .10 level
* Significant at .05 level
** Significant at .01 level

APPENDIX D

Figure 1

Stimuli and Representative Visual Displays

for Peripheral Localization



[1]Stimuli on Center and Peripheral rings
[2]Stimuli on Center and Intermediate rings

Table 1

Target Stimuli and Stimulus Locations for Each Trial for Peripheral Localization

	Form			Letters	
Trial	Stimulus	Location[1]	Trial	Stimulus	Ring
1	Triangle	P	1	C	M
2	Hexagon	C	2	E	C
3	Oval	C	3	F	P
4	Square	M	4	U	P
5	Circle	C	5	T	M
6	Rt. Triangle	M	6	F	C
7	Triangle	C	7	O	C
8	Trapezoid	C	8	E	M
9	Oval	P	9	T	P
10	Rectangle	M	10	O	P
11	Oval	M	11	A	M
12	Square	P	12	C	P
13	Hexagon	P	13	Y	C
14	Rectangle	P	14	F	M
15	Trapezoid	M	15	A	C
16	Rt. Triangle	C	16	O	M
17	Hexagon	M	17	C	C
18	Triangle	M	18	A	P
19	Rectangle	C	19	E	P
20	Circle	M	20	U	C
21	Circle	P	21	Y	P
22	Square	C	22	T	C
23	Trapezoid	P	23	U	M
24	Rt. Triangle	P	24	Y	M

[1] Center, Middle, or Peripheral Rings

Table 2

Analysis of Variance of Angular Errors for Form and Letter Sets Under the Different Experimental Conditions

		Form		Letter	
Source	df	MS	F	MS	F
Between Subjects	91				
Intelligence (I)	2	4387.70	4.51*	5994.53	7.71**
Motivation (M)	1	1523.90	1.57	1377.48	1.77
Order (O)	1	3677.79	3.78*	169.80	
I x M	2	2098.43	2.16	493.42	
I x O	2	1415.38	1.45	39.02	
M x O	1	94.17		7.72	
I x M x O	2	138.45		109.16	
Residual (b)	80	973.40		777.26	
Within Subjects	460				
Session (S)	1	1722.81	5.39*	3337.08	8.88**
I x S	2	468.32	1.48	382.14	1.02
M x S	1	160.12		905.84	2.41
O x S	1	2.93		345.29	
I x M x S	2	173.35		516.63	1.37
I x O x S	2	123.98		582.35	1.55
M x O x S	1	64.29		5.32	
I x M x O x S	2	281.91		565.79	1.51
Residual (w_1)	80	319.71		375.85	
Position (P)	2	6409.91	27.90**	13197.10	54.72**
I x P	4	466.41	2.05+	426.78	1.77
M x P	2	1084.79	4.72**	503.67	2.09
O x P	2	216.96		468.57	1.94
I x M x P	4	653.61	2.85*	451.60	1.87
I x O x P	4	251.71	1.11	319.72	1.33
M x O x P	2	656.20	2.80*	86.51	
I x M x O x P	4	516.07	2.27*	324.77	1.35
Residual (w_2)	160	229.70		241.18	
Session x Position	2	176.65		880.36	1.36
I x S x P	4	29.15		431.60	
M x S x P	2	63.27		122.54	
O x S x P	2	29.68		16.79	
I x M x S x P	4	235.67		114.86	
I x O x S x P	4	320.40		418.38	
M x O x S x P	2	94.10		6.18	
I x M x O x S x P	4	348.48		88.24	
Residual (w_3)	160	630.42		649.28	

+ Significant at .10 level
* Significant at .05 level
** Significant at .01 level

Table 3

Analysis of Variance of Linear Errors for the Form and Letter Sets Under the Different Experimental Conditions

		Form		Letter	
Source	df	MS	F	MS	F
Between Subjects	91				
Intelligence (I)	2	2.42	3.67*	1.88	2.55+
Motivation (M)	1			.01	
Order (O)	1	1.68	2.54	2.02	2.75+
I x M	2	2.07	3.14*	.71	
I x O	2	1.14	1.72	.23	
M x O	1	.26		.10	
I x M x O	2	.01		.08	
Residual (b)	80	.66		.74	
Within Subjects	460				
Session (S)	1	1.11	5.53*	2.26	11.45**
I x S	2	.03		.21	1.07
M x S	1	.08		.68	3.44+
O x S	1	.02		.09	
I x M x S	2	.14		.55	2.77+
I x O x S	2	.38	1.88	.00	
M x O x S	1	.14			
I x M x O x S	2	.08			
Residual (w_1)	80	.20		.20	
Position (P)	2	11.28	30.32**	7.23	27.93**
I x P	4	.45	1.22	.20	
M x P	2	.03		.35	1.35
O x P	2	.46	1.23	.08	
I x M x P	4	.52	1.40	.18	
I x O x P	4	.21		.26	
M x O x P	2	.16		.02	
I x M x O x P	4	.60	1.61	.24	
Residual (w_2)	160	.37		.26	
Session x Position	2	.35		1.35	2.79+
I x S x P	4	.08		.19	
M x S x P	2	.14		.01	
O x S x P	2	.06		.36	
I x M x S x P	4	.10		.15	
I x O x S x P	4	.13		.16	
M x O x S x P	2	.15		.02	
I x M x O x S x P	4	.06		.09	
Residual (w_3)	160	.59		.48	

+ Significant at .10 level
* Significant at .05 level
** Significant at .01 level

Table 4

Analysis of Variance of Combined Angular and Linear Errors (Z-Scores) for Form and Letter Sets Under the Different Experimental Conditions

		Form		Letter	
Source	df	MS	F	MS	F
Between Subjects	91				
Intelligence (I)	2	49.50	7.28**	45.25	7.43**
Motivation (M)	1	1.25		3.41	
I x M	2	13.33	1.96	6.60	1.08
Residual (b)	86	6.80		6.09	
Within Subjects	460				
Session (S)	1	10.38	8.10**	31.45	16.76**
I x S	2	.25		2.56	1.36
M x S	1	1.64	1.28	5.48	2.92+
I x M x S	2	.95		5.96	3.18*
Residual (w_1)	86	1.28		1.88	
Position (P)	2	119.76	63.20**	112.41	65.86**
I x P	4	1.39		1.38	
M x P	2	.40		.11	
I x M x P	4	8.46	4.46**	1.26	
Residual (w_2)	172	11.90		1.71	
Session x Position	2	1.30		12.11	3.34*
I x S x P	4	.67		2.90	
M x S x P	2	3.81	1.05	.17	
I x M x S x P	4	1.18		.81	
Residual (w_3)	172	3.63		3.63	

+ Significant at .10 level
* Significant at .05 level
** Significant at .01 level

Table 5

Analysis of Variance of Linear Constant Errors for Form and Letter Sets Under Different Experimental Conditions

		Form		Letter	
Source	df	MS	F	MS	F
Between Subjects	91				
Intelligence (I)	2	.86		.73	
Motivation (M)	1	.32		.16	
Order (O)	1	.09		1.21	
I x M	2	7.06	3.20*	5.15	3.75*
I x O	2	.23		1.15	
M x O	1	.85		.75	
I x M x O	2	2.15		3.72	2.71+
Residual (b)	80	2.21		1.38	
Within Subjects	460				
Session (S)	1	2.56	6.22*	3.40	6.99*
I x S	2	.15		.07	
M x S	1	.03		.13	
O x S	1	.10		.02	
I x M x S	2	.10		.13	
I x O x S	2	.34		.26	
M x O x S	1	1.92	4.67*	.51	1.04
I x M x O x S	2	.43	1.04	.15	
Residual (w_1)	80	.41		.49	
Position (P)	2	131.03	211.34**	66.32	104.77**
I x P	4	2.27	3.67**	.66	1.04
M x P	2	.88	1.42	1.43	2.26
O x P	2	4.13	6.66**	.32	
I x M x P	4	1.09	1.76	1.24	1.96
I x O x P	4	2.64	4.26*	.30	
M x O x P	2	.18		.59	
I x M x O x P	4	1.21	1.95	.15	
Residual (w_2)	160	.62		.63	
Session x Position	2	.46		.74	
I x S x P	4	.26		.45	
M x S x P	2	.06		.51	
O x S x P	2	.02		.35	
I x M x S x P	4	.23		.27	
I x O x S x P	4	.36		.08	
M x O x S x P	2	.00		.01	
I x M x O x S x P	4	.32		.11	
Residual (w_3)	160	1.13		1.10	

+ Significant at .10 level
* Significant at .05 level
** Significant at .01 level

APPENDIX E

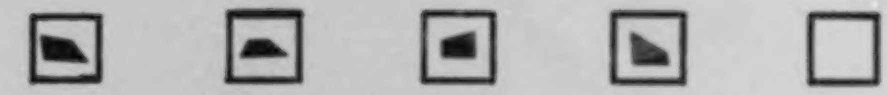
Figure 1

Stimuli and Visual Displays Used for

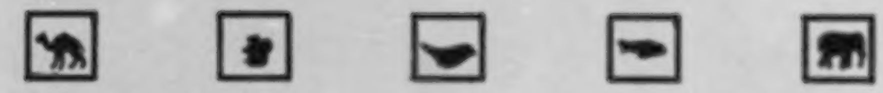
Peripheral Sensitivity II

STIMULI

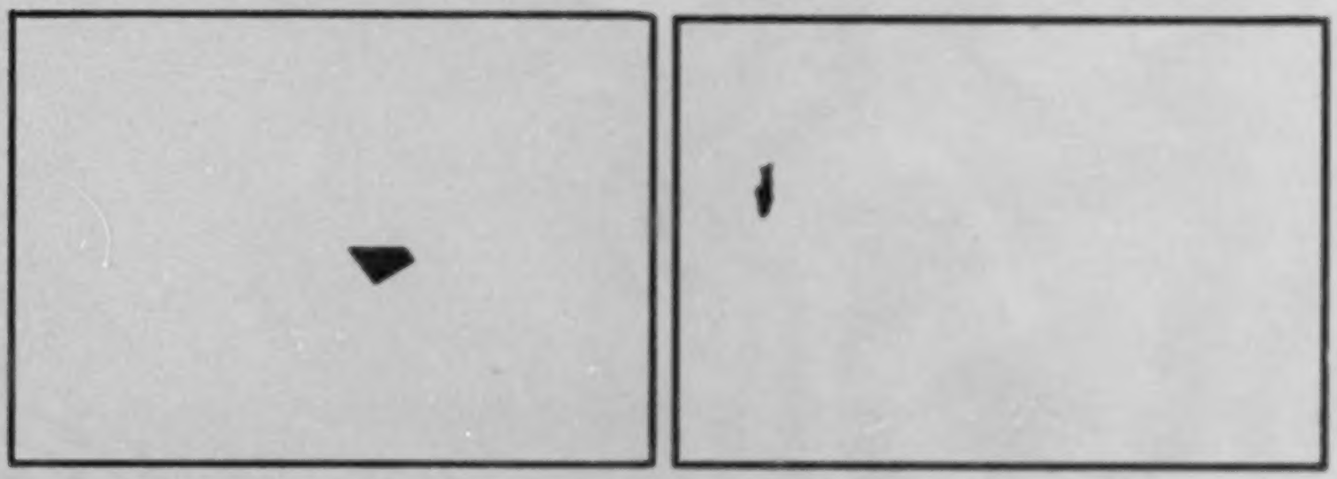
Experimental Trials:



Training Trials:



SAMPLE VISUAL DISPLAYS



Experimental[1]

Training[2]

[1] Stimulus on Center

[2] Stimulus on Peripheral ring

Table 1

Target Stimuli and Stimulus Locations for Peripheral Sensitivity

(Experiment IV)

Trial	Stimulus[1]	Location[2]	Trial	Stimulus	Location
1	C	C	25	D	C
2	C	P	26	D	M
3	E	C	27	E	C
4	B	P	28	E	C
5	C	C	29	E	P
6	B	M	30	B	C
7	D	P	31	B	C
8	B	C	32	D	C
9	D	P	33	E	P
10	B	M	34	C	M
11	E	M	35	B	M
12	C	C	36	D	M
13	P	B	37	B	P
14	C	M	38	E	C
15	C	P	39	D	M
16	D	C	40	E	P
17	C	C	41	D	C
18	D	P	42	B	M
19	C	M	43	C	P
20	E	P	44	D	M
21	D	P	45	E	M
22	B	P	46	E	M
23	C	P	47	E	M
24	B	C	48	C	M

[1] See Fig. 1, Appendix E, p. 130.

[2] Center, Middle, or Peripheral rings

Table 2

Analysis of Variance of Recognition Accuracy Scores

Under the Different Experimental Conditions

Source	df	MS	F
Between Subjects	11		
Training Groups (G)	2	2.05	
Residual (b)	9	13.14	
Within Subjects	60		
Session (S)	1	11.68	1.47
G x S	2	3.01	
Residual (w_1)	9	7.94	
Position (P)	2	16.17	8.06**
G x P	4	2.40	1.20
Residual (w_2)	18	2.01	
Session x Position	2	12.39	5.14*
G x S x P	4	4.78	1.98
Residual (w_3)	18	2.41	

+ Significant at .10 level
* Significant at .05 level
** Significant at .01 level

Table 3

Analysis of Variance of Angular and Linear Errors

Under the Different Experimental Conditions

		Angular		Linear	
Source	df	MS	F	MS	F
Between Subjects	11				
Training Groups (G)	2	100.40		6.16	1.08
Residual (b)	9	501.86		5.69	
Within Subjects	60				
Session (S)	1	161.78	1.10	.54	
G x S	2	270.41	1.84	1.21	2.23
Residual (w_1)	9	146.76		.55	
Position (P)	2	1952.09	7.96**	100.50	76.97**
G x P	4	151.50		1.06	
Residual (w_2)	18	245.19		1.31	
Session x Position	2	280.35	1.43	.06	
S x P x G	4	286.76	1.46	.35	3.50*
Residual (w_3)	18	196.11		.10	

+ Significant at .10 level
* Significant at .05 level
** Significant at .01 level

Table 4

Analysis of Variance of Linear Constant Errors

Under the Different Experimental Conditions

Source	df	MS	F
Between Subjects	11		
Training Groups (G)	2	1525.23	1.85
Residual (b)	9	823.73	
Within Subjects	60		
Session (S)	1	1113.86	1.55
G x S	2	467.81	
Residual (w_1)	9	717.04	
Position (P)	2	712.86	2.06
G x P	4	318.20	
Residual (w_2)	18	346.47	
Session x Position	2	300.27	
G x S x P	4	84.43	
Residual (w_3)	18	465.32	

+ Significant at .10 level
* Significant at .05 level
** Significant at .01 level

APPENDIX F

Table 1

Composition of Experimental Trials for Both Stimulus Sets (FC-NS and NS-FC)

	Trials
Training trials without Incidental cue:	1, 3, 6, 7, 9, 13, 14, 16, 17, 19
Training trials with Incidental cue:	2, 4, 5, 8, 10, 11, 12, 15, 18, 20
Dominance task stimuli:	21, 22, 23, 24, 25, 26
Transfer task stimuli:	27, 28, 29, 30, 31, 32, 33, 34, 35, 36, 37, 38, 39, 40, 41, 42, 43, 44

Table 2

Analysis of Variance of Number of Trials to Criterion on Concept Transfer (VM) Under the Different Experimental Conditions

Source	df	MS	F
Between Subjects	76		
Intelligence (I)	2	332.96	2.37+
Motivation (M)	1	366.36	2.60
Order (O)	1	652.16	4.63*
I x M	2	262.68	1.87
I x O	2	291.98	2.07
M x O	1	1.28	
I x M x O	2	39.34	
Residual (b)	65	140.76	
Within Subjects	77		
Session (S)	1	344.54	2.84+
S x I	2	179.58	1.48
S x M	1	22.36	
S x O	1	154.05	1.27
S x I x M	2	30.32	
S x I x O	2	20.72	
S x M x O	1	9.63	
S x I x M x O	2	160.48	1.32
Residual (W)	65	121.27	

+ Significant at .10 level
* Significant at .05 level
** Significant at .01 level

Table 3

Analysis of Variance of Number of Trials to Criterion on Concept Transfer (VM) for Each Order of Presentation

		Order I (FC - NS)		Order II (NS - FC)	
Source	df	MS	F	MS	F
Between Subjects	41				
Intelligence (I)	2	486.09	3.12+	187.17	1.92
Motivation (M)	1	193.32		186.64	1.92
I x M	2	102.64		188.48	1.94
Residual (b)	36	155.97		97.39	
Within Subjects	42				
Session (S)	1	16.97		435.54	8.69**
I x S	2	117.24		94.24	1.88
M x S	1	2.61		27.79	
I x M x S	2	67.11		117.20	2.34+
Residual (w)	36	150.99		50.10	

+ Significant at .10 level
* Significant at .05 level
** Significant at .01 level

Table 4

Analysis of Variance of Number of Trials to Criterion
on Concept Transfer (VM) Under the
Different Experimental Conditions
(Learners Only)

		Order I (FC - NS)			Order II (NS - FC)	
Source	df	MS	F	df	MS	F
Between Subjects	21			27		
Intelligence (I)	2	277.35	8.62**	2	7.77	
Motivation (M)	1	34.76	1.08	1	1.30	
I x M	2	38.22	1.19	2	19.89	
Residual (b)	16	32.18		22	70.27	
Within Subjects	22			28		
Session (S)	1	14.60		1	192.14	2.96+
S x I	2	37.82		2	59.88	
S x M	1	182.04	4.12+	1	192.14	2.96+
S x I x M	2	80.88	1.83	2	136.16	2.10
Residual (w)	16	44.19		22	64.89	

+ Significant at .10 level
* Significant at .05 level
** Significant at .01 level

Appendix G

Table 1

Analysis of Variance of Errors on Pattern Transfer (KM)

Under the Different Experimental Conditions

(Experiment VI)

Source	df	MS	F
Between Subjects	43		
Intelligence (I)	2	19.95	1.75
Motivation (M)	1	2.39	
M x I	2	5.06	
Residual (b)	38	11.42	
Within Subjects	484		
Session (S)	1	58.83	6.51*
I x S	2	3.84	
M x S	1	5.40	
I x M x S	2	1.08	
Residual (w_1)	38	9.04	
Trials (T)	5	10.56	3.80**
I x T	10	1.62	
M x T	5	1.18	
I x M x T	10	1.88	
Residual (w_2)	190	2.78	
Session x Trial	5	1.86	
I x T x S	10	2.59	
M x S x T	5	3.53	
I x M x S x T	10	7.23	1.05
Residual (w_3)	190	6.87	

+ Significant at .10 level
* Significant at .05 level
** Significant at .01 level

Table 2

Analysis of Variance of Correct Responses on Pattern Transfer (KM) Under the Different Experimental Conditions

(Experiment VII)

Source	df	MS	F
Between Subjects	39		
Intelligence (I)	2	10.32	1.51
Motivation (M)	1	9.65	1.42
I x M	2	3.96	
Residual (b)	34	6.82	
Within Subjects	80		
Trials (T)	2	5.69	2.50
I x T	4	5.50	2.41
M x T	2	.58	
I x M x T	4	10.71	4.70**
Residual (w)	68	2.28	

+ Significant at .10 level
* Significant at .05 level
** Significant at .01 level

Table 3

Analysis of Variance of Correct Turns on Orientation Task Under the Different Experimental Conditions

Source	df	MS	F
Between Subjects	39		
Intelligence (I)	2	1.43	2.69+
Motivation (M)	1	.32	
I x M	2	.39	
Residual (b)	34	.53	
Within Subjects	600		
Pre-Post (P)	1	.05	
I x P	2	.07	
M x P	1	1.00	8.03**
Residual (w_1)	34	.13	
Orientation (O)	3	3.58	19.69**
I x O	6	.19	1.03
M x O	3	.23	1.27
I x M x O	6	.08	
Residual (w_2)	102	.18	
Direction (D)	1	.06	
I x D	2	.05	
M x D	1	.01	
I x M x D	2	.02	
Residual (w_3)	34	.12	
Pre-Post x Orientation	3	.07	
I x P x D	6	.06	
M x P x D	3	.43	1.28
I x M x S x D	6	.16	
Residual (w_4)	102	.34	
Pre-Post x Direction	1	.01	
I x P x D	2	.08	
M x P x D	1	.01	
I x M x P x D	2	.05	
Residual (w_5)	34	.35	
Orientation x Direction	3	.09	
I x O x D	6	.04	
M x O x D	3	.17	
I x M x O x D	6	.05	
Residual (w_6)	102	.32	
Pre-Post x Orient. x Direct.	3	.09	
I x P x O x D	6	.12	
M x P x O x D	3	.19	
I x M x P x O x D	6	.08	
Residual (w_7)	102	.59	

+ Significant at .10 level
* Significant at .05 level
** Significant at .01 level